

Draft Environmental Assessment

Zipline International Inc. Drone Package Delivery Operations Kannapolis, NC and Surrounding Area



January 2022

**United States Department of Transportation
Federal Aviation Administration**

Washington, D.C.

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DEPARTMENT of TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

**Notice of Availability, Notice of Public Comment Period, and Request for Comment on the
Draft Environmental Assessment for Zipline International's Drone Package Delivery Operations in
Kannapolis, North Carolina and Surrounding Area**

The Federal Aviation Administration (FAA) hereby gives Notice of Availability (NOA) for the Draft Environmental Assessment (EA) evaluating the potential effects of the FAA decision to authorize Zipline International, Inc. to conduct unmanned aircraft (UA) commercial package delivery operations from one location, or "nest," in Kannapolis, North Carolina.

Zipline is seeking a Part 135 Air Carrier certificate with associated Operations Specifications (OpSpecs) to begin its commercial package delivery operations to the north of Charlotte. The federal action subject to this EA is the requested FAA approval of Zipline's OpSpecs to include a paragraph with descriptive language about the operating area boundaries, which includes the specific locations and operational profile in Zipline's request.

The Draft EA has been prepared in accordance with the requirements set forth in the Council on Environmental Quality (CEQ) regulations at Title 40, Code of Federal Regulations (CFR), parts 1500-1508, *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* and FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*.

The public comment period for the Draft EA begins with the issuance of this Notice of Availability and lasts 14 days. The FAA encourages all interested parties to provide comments concerning the scope and content of the Draft EA by January 27, 2022, or 14 days from the date of publication of this Notice of Availability, whichever is later. The Draft EA is available to view/download electronically at https://www.faa.gov/uas/advanced_operations/nepa_and_drones/

Comments may be directed in writing to 9-FAA-Drone-Environmental@faa.gov. Please reference the Zipline Kannapolis Draft EA in the email subject line when sending comments. Comments should be submitted as a separate document and not embedded in the Draft EA.

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, be advised that your entire comment – including your personal identifying information – may be made publicly available at any time. While you can ask us in your comment to withhold from public review your personal identifying information, we cannot guarantee that we will be able to do so.

Posted: January 13, 2022

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Contents

1.0	PURPOSE AND NEED	1
1.1	Introduction	1
1.2	Background and Location.....	1
1.2.1	Nest Location	3
1.3	Purpose and Need.....	4
1.3.1	FAA Purpose and Need	4
1.3.2	Zipline’s Purpose and Need	5
1.4	Public Involvement.....	5
2.0	PROPOSED ACTION AND ALTERNATIVES	6
2.1	Proposed Action.....	6
2.2	No Action Alternative.....	7
3.0	AFFECTED ENVIRONMENT and ENVIRONMENTAL CONSEQUENCES.....	8
3.1	Resources Not Analyzed in Detail	8
3.2	Biological Resources (Including Fish, Wildlife and Plants)	10
3.2.1	Regulatory Setting.....	10
3.2.2	Affected Environment.....	11
3.2.3	Environmental Consequences.....	12
3.3	Department of Transportation Act, Section 4(f) Resources	14
3.3.1	Regulatory Setting.....	14
3.3.2	Affected Environment.....	15
3.3.3	Environmental Consequences.....	15
3.4	Historical, Architectural, Archaeological, and Cultural Resources.....	15
3.4.1	Regulatory Setting.....	15
3.4.2	Affected Environment.....	16
3.4.2	Environmental Consequences.....	16
3.5	Noise and Noise-Compatible Land Use.....	17
3.5.1	Regulatory Setting.....	17
3.5.2	Affected Environment.....	17
3.5.3	Environmental Consequences.....	18
3.6	Environmental Justice	20
3.6.1	Regulatory Setting.....	20
3.6.2	Affected Environment.....	21

3.6.3	Environmental Consequences.....	21
3.7	Visual Effects (Visual Resources and Visual Character)	21
3.7.1	Regulatory Setting.....	21
3.7.2	Affected Environment.....	22
3.7.3	Environmental Consequences.....	22
3.8	Water Resources (Surface Waters).....	22
3.8.1	Regulatory Setting.....	22
3.8.2	Affected Environment.....	22
3.8.3	Environmental Consequences.....	22
4.0	LIST OF PREPARERS and CONTRIBUTORS	24
5.0	LIST of AGENCIES CONSULTED	25

Table of Figures

Figure 1	Study Area Shown in the north side of the Charlotte Metropolitan Area	2
Figure 2	Zipline's Nest Location in Kannapolis, NC, with Launch and Recovery Paths	3
Figure 3	Closer View of Zipline's Nest Location along the Kannapolis Parkway	4
Figure 4	DNL 45 dB or greater noise exposure at Kannapolis nest location.....	19

Appendices

Appendix A:	IPaC Report
Appendix B:	Tribal and Historic Outreach Letters
Appendix C:	Noise Analysis Report
Appendix D:	Non-Standard Noise Methodology Memos
Appendix E:	EJSCREEN Report
Appendix F:	Acronyms and Abbreviations

1.0 PURPOSE AND NEED

1.1 Introduction

Zipline International Inc. (Zipline) is seeking its air carrier Operations Specifications (OpSpecs) and other Federal Aviation Administration (FAA) approvals necessary to begin unmanned aircraft (UA) commercial package delivery operations from one hub, or “nest,” location in Kannapolis, North Carolina, using its 46-pound “Zip” UA.¹ Zipline projects operating a maximum of 20 delivery flights per operating day from the Kannapolis nest based on the scope of the proposed action, discussed in Section 2.1. Zipline anticipates that operational demand could increase the number of delivery flights per day; however, additional regulatory approvals and environmental review would be needed before this increase in operations could be approved. Novant Health previously contracted with Zipline to carry its own hospital supplies on two routes from the same Kannapolis nest beginning in May 2020, delivering supplies in response to the COVID-19 health emergency under Part 107 operating authorities. Zipline would use some of that same route structure for the operations discussed in the proposed action, however, Zipline is planning to conduct deliveries to customers in 16 communities total. The proposed operations would occur during daylight hours up to seven days per week, with no flights on holidays. No nighttime operations are anticipated or requested under the proposed action. The approval of Zipline’s OpSpecs to include this new operating area is considered a major federal action subject to environmental review requirements.

This Draft Environmental Assessment (EA) is being prepared by the FAA to evaluate the potential environmental impacts that may result from FAA’s approval of the proposed action, which would enable UA commercial delivery operations from a nest located in Kannapolis, North Carolina to a delivery area within a 257-square mile airspace box located north of Charlotte, depicted in Figure 1 below (the operating area). The FAA has prepared this EA pursuant to the National Environmental Policy Act of 1969 (NEPA) [42 United States Code (U.S.C.) § 4321 et seq.] and its implementing regulations (40 Code of Federal Regulations (CFR) §§1500-1508)). NEPA requires federal agencies to consider the environmental effects of proposed federal actions and to disclose to decision-makers and the interested public a clear and accurate description of the potential environmental impacts of proposed major federal actions. Under NEPA, federal agencies are required to consider the environmental effects of a proposed action, the reasonable alternatives to the proposed action, and a no action alternative (assessing the potential environmental effects of not implementing the proposed action). The FAA has established a process to ensure compliance with the provisions of NEPA through FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures* and the FAA Order 1050.1F Desk Reference.

1.2 Background and Location

In 2012, Congress first charged the FAA with integrating unmanned aircraft systems (UAS) into the National Airspace System (NAS).² The FAA has engaged in a phased, incremental approach to integrating UAS into the NAS and continues to work toward full integration of UAS into the NAS. Part of that approach involves providing safety review and oversight of proposed operations to begin commercial UA delivery in the NAS.

¹ A nest is a ground based service area where UA are assigned and where flights originate and return.

² 49 U.S.C. 44802; FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, Sec. 332. 126 Stat. 11, 73 (2012).

Over the past several years Zipline has been working under FAA programs, including the UAS Integration Pilot Program (IPP),³ the Partnership for Safety Plan (PSP) Program,⁴ and the BEYOND program,⁵ as well as the FAA's established processes to bring certificated commercial UA delivery into practice. Participants in these programs are among the first to prove their concepts, including package delivery by UA, through the use of current regulations and exemptions and waivers from some of these regulatory requirements.

Zipline has applied to the FAA for a Part 135 air carrier operating certificate, which would allow it to carry the property of another for compensation or hire beyond visual line of sight (BVLOS). Zipline anticipates receiving its operating certificate in the first half of 2022. The certificate contains a stipulation that operations must be conducted in accordance with the provisions and limitations specified in its OpSpecs. Zipline's current request for OpSpecs to specify an area of operations, in conjunction with other related FAA approvals, such as a waiver of 14 CFR 91.113(b) to enable BVLOS operations and a Certificate of Waiver or Authorization (COA), would enable commercial delivery operations in the operating area.

The location is shown in Figure 1 below, with the operating area outlined in yellow and the nest location identified using the orange hexagon. The area should also be considered as the study area for the purposes of this Draft EA.

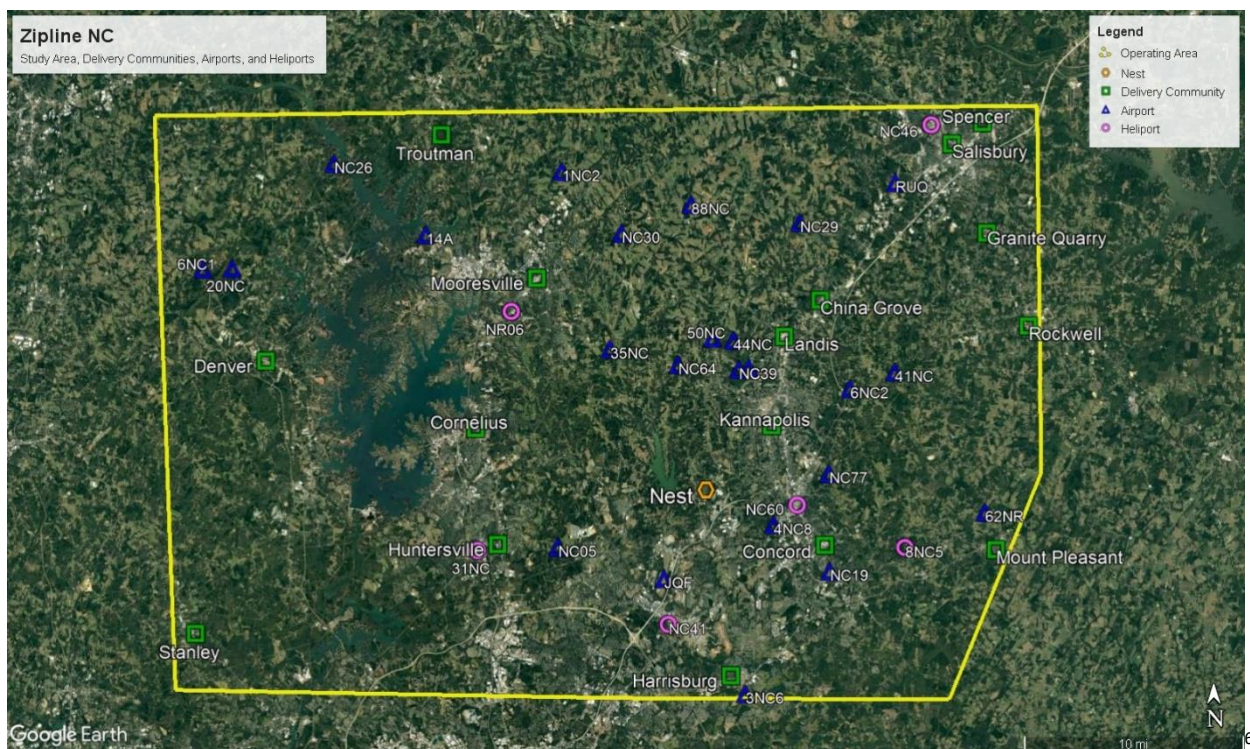


Figure 1 Study Area Shown in the north side of the Charlotte Metropolitan Area

³ The UAS IPP was announced on October 25, 2017 via a Presidential Memorandum, which has the force and effect of law on executive agencies. https://www.faa.gov/uas/programs_partnerships/completed/integration_pilot_program/

⁴ https://www.faa.gov/uas/programs_partnerships/psp/

⁵ https://www.faa.gov/uas/programs_partnerships/beyond/

⁶ Image: Google Earth, as modified by the FAA

Zipline proposes to conduct deliveries from this nest location to vetted delivery sites such as medical centers, healthcare facilities, private homes, and consumer product facilities.⁷ In May 2020, Novant Health contracted with Zipline to carry its own supplies on two routes from this nest location in response to the COVID-19 public health emergency under a Part 107 Certificate of Waiver (CoW) issued to Novant Health by the FAA. The deliveries were conducted to healthcare facilities in the region. The FAA conducted a NEPA review for the limited UAS delivery operations along those four routes as part of issuance of the CoW. No significant environmental impacts or extraordinary circumstances were identified in the review, and the FAA determined that this action was subject to the categorical exclusion (CATEX) described in Paragraph 5.6.5(j) of FAA Order 1050.1F. Zipline is now planning similar operations under its Part 135 air carrier certificate, although more delivery areas will be added under this proposed action.

1.2.1 Nest Location

The nest is located at the Stewart-Haas Racing campus at 2030 Kannapolis Parkway in Kannapolis, NC, approximately 25 miles northeast of Charlotte. The property is zoned for commercial use. The area to the south and east of the nest includes several large logistics and distribution centers. To the north-east of the nest are several privately-owned rural properties. Immediately to the west is the Kannapolis Parkway, with a residential neighborhood across the parkway from the nest. See Figures 2 and 3 below.

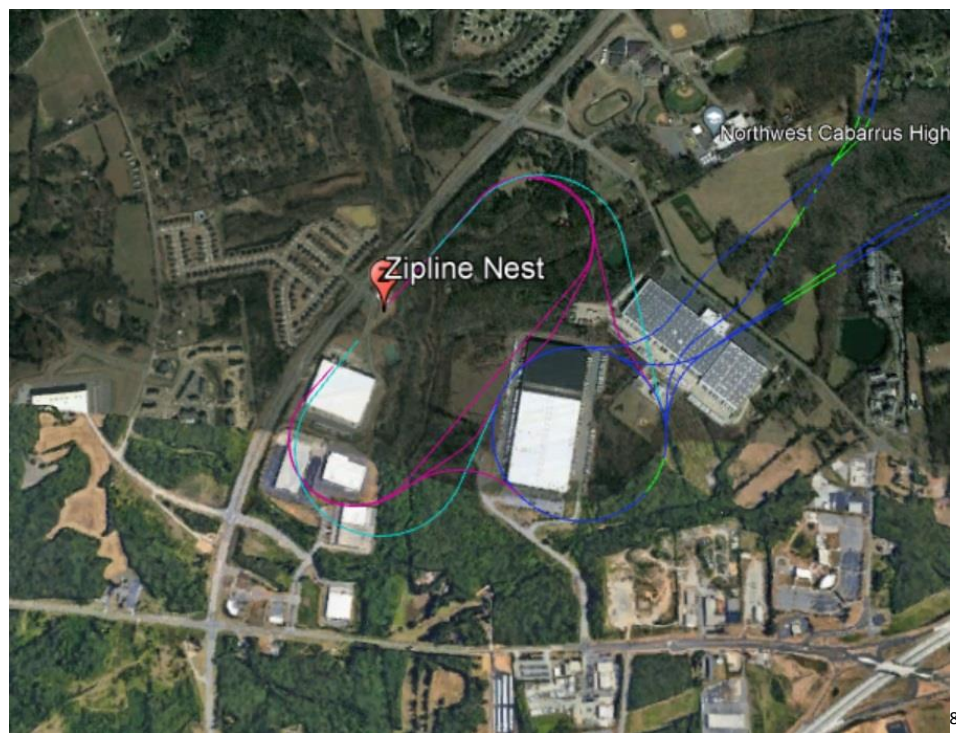


Figure 2 Zipline's Nest Location in Kannapolis, NC, with Launch and Recovery Paths

⁷ Each delivery site is pre-approved by Zipline to ensure that the area is capable of receiving deliveries.

⁸ Image: Google Earth, as modified by the FAA

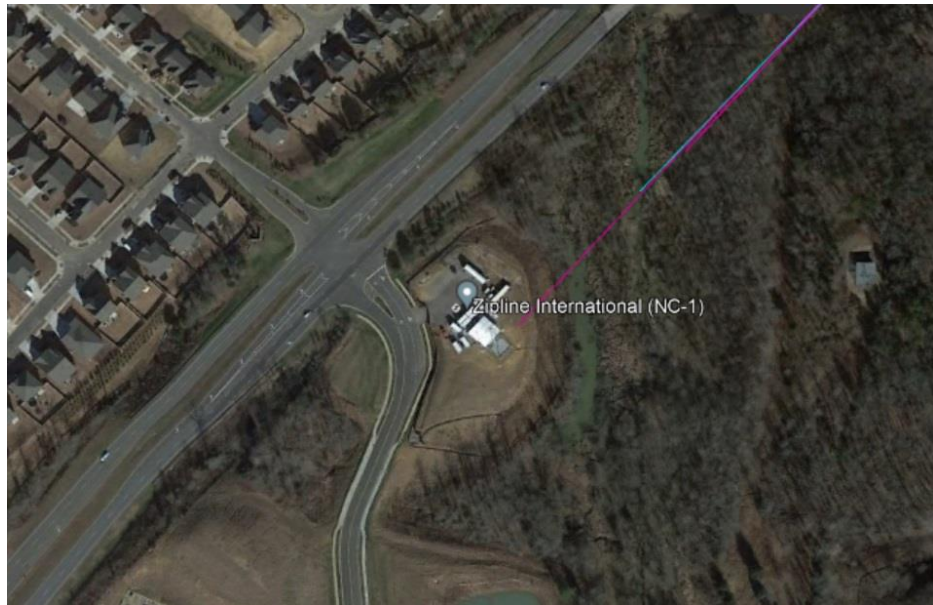


Figure 3 Closer View of Zipline's Nest Location along the Kannapolis Parkway

1.3 Purpose and Need

As described in FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, the Purpose and Need section of an EA briefly describes the underlying purpose and need for the proposed federal action. It presents the problem being addressed and describes what the FAA is trying to achieve with the proposed action.

1.3.1 FAA Purpose and Need

The FAA has multiple approvals, such as a waiver of 14 CFR 91.113(b) to enable BVLOS operations and a COA, associated with the operations north of Charlotte; the FAA issuance of the OpSpecs is the approval that will ultimately enable UA commercial delivery operations in this area. Zipline's request for OpSpecs to add a new area of operations requires FAA review and approval.

The FAA has a statutory obligation to review Zipline's request to issue the OpSpecs and determine whether the amendment would affect safety in air transportation or air commerce and the public interest requires the amendment. In general, Congress has charged FAA to encourage the development of civil aeronautics and the safety of air commerce in the United States. 49 U.S.C. §40104.

In addition, the FAA has specific statutory and regulatory obligations related to its issuance of a Part 135 certificate and the related OpSpecs. The FAA is required to issue an operating certificate to an air carrier when it "finds, after investigation, that the person properly and adequately is equipped and able to operate safely under this part and regulations and standards prescribed under this part." 49 U.S.C. §44705. An operating certificate also specifies "terms necessary to ensure safety in air transportation; and (2)...the places to and from which, and the airways of the United States over which, a person may operate as an air carrier." *Id.* Also included in air carrier certificates is a stipulation that the air carrier's operations must be conducted in accordance with the provisions and limitations specified in OpSpecs. 14 CFR §119.5 (g), (l). The regulations also specify that a Part 135 certificate holder may not operate in a

⁹ Image: Google Earth, as modified by the FAA

geographical area unless its OpSpecs specifically authorize the certificate holder to operate in that area. 14 CFR 119.5(j). The regulations implementing Section 44705 specify that an air carrier's approved OpSpecs must include, among other things, "authorization and limitations for routes and areas of operations." 14 CFR §119.49(a)(6). An air carrier's OpSpecs may be amended at the request of an operator if the FAA "determines that safety in air commerce and the public interest allows the amendment." 14 CFR §119.51(a); see also 49 U.S.C. §44709. After making this determination, FAA must take an action on the OpSpec amendment.

1.3.2 Zipline's Purpose and Need

The purpose of Zipline's request is to begin UA commercial delivery service, including medical product delivery, in the area north of Charlotte, which, in its business judgment, Zipline has determined is an appropriate market for initial operations. Zipline's requested OpSpecs are needed so that Zipline can begin limited UA commercial delivery operations from its Kannapolis nest location. The approval will offer Zipline an opportunity to assess the viability of the UA commercial delivery option under real world conditions and demonstrate that it can conduct operations safely and meet its compliance obligations. The approval could also help Zipline gauge public demand for UA commercial delivery services and evaluate whether scalable and cost-effective UA delivery expansion is possible in the area. In addition, the approval could provide an opportunity to assess community response to commercial delivery operations in the area.

1.4 Public Involvement

The FAA created a Notice of Availability (NOA) with information about the EA and provided it to local interest groups, including local government officials, 4(f) resource authorities, and the State Historic Preservation Office (SHPO) and Tribal Historic Preservation Office (THPO) discussed in this EA. The NOA provided information about the proposed action and requested review and comments on this EA, which was published on the FAA website in January 2022 for a 14-day comment period. Interested parties were invited to submit comments on any environmental concerns relating to the proposed action to a specifically assigned email address.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

In order for Zipline to conduct UA package deliveries in a new location, it must receive a number of approvals from FAA, such as a waiver of 14 CFR 91.113(b) to enable BVLOS operations and a COA. Further, Zipline has requested the FAA to approve its OpSpecs so that they can begin commercial delivery operations once they receive their Part 135 air carrier certificate. The OpSpec approval is the FAA action that ultimately would enable commercial delivery operations in the operating area, located north of Charlotte.

The B050 OpSpec, *Authorized Areas of En Route Operations, Limitations, and Provisions*, includes a reference section titled Limitations, Provisions, and Special Requirements. The amendment to this reference section – to add a new paragraph with descriptive language about the operating area boundaries, including the specific location and operational profile proposed in Zipline’s request – is the proposed federal action for this EA. The OpSpecs will restrict Zipline to this particular location; any future expansion beyond the authorization and limitations for the area of operations described in the B050 OpSpec, or beyond the current 1:1 pilot to aircraft ratio described in Zipline’s A003 OpSpec, *Airplane/Aircraft Authorization*, will require additional OpSpec amendments from the FAA and will receive appropriate NEPA review at that time.

Zipline anticipates that the proposed UA commercial delivery operations will be conducted to the 16 communities on the north side of the Charlotte Metropolitan Area shown in Table 2-1. All of these communities fall within the study area as outlined in yellow in Figure 1.

Table 2-1 Anticipated Delivery Communities within Study Area

Anticipated Delivery Communities			
Troutman	Huntersville	Kannapolis	Granite Quarry
Mooresville	Harrisburg	Landis	Salisbury
Denver	Concord	China Grove	Spencer
Stanley	Mount Pleasant	Rockwell	Cornelius

Zipline projects operating a maximum of 20 delivery flights per operating day from the Kannapolis nest based on the scope of the proposed action. Zipline anticipates that operational demand could increase the number of delivery flights per day; however, additional regulatory approvals and environmental review would be needed before this increase in operations could be approved. The operations would occur during daylight hours up to seven days per week, with no flights on holidays. The UA is capable of nighttime operations; however no nighttime deliveries are anticipated or requested under the proposed action. Delivery operations are anticipated to be distributed rather evenly across the 16 communities listed on Table 2-1.

The UA has a maximum takeoff weight of 46 pounds, including a payload of 3.9 pounds. It is a fixed-wing drone that uses electric power from rechargeable lithium ion batteries. It is launched from a catapult system, and retrieved with a wire capture line. The aircraft includes a parachute safety system that can be deployed in cases of emergency.

2.2 No Action Alternative

The alternative to the proposed action is the no action alternative, where FAA would not issue the approvals necessary, including the amendment to the OpSpecs, to enable Zipline to conduct UA commercial package delivery operations in the operating area. This alternative does not support the stated purpose and need. However, it was retained as required by the CEQ regulations (40 CFR 1502.14(c)).

3.0 AFFECTED ENVIRONMENT and ENVIRONMENTAL CONSEQUENCES

This section provides a description of the environmental resources that would be affected by the proposed action, as required by the CEQ regulations and FAA Order 1050.1F. The level of detail provided in this section is commensurate with the importance of the impact on these resources (40 CFR § 1502.15). The general study area for each resource is the entire area within the yellow-lined boundary of Figure 2 in this report. As required by FAA Order 1050.1F, this EA presents an evaluation of impacts for the environmental impact categories listed below.

- Air Quality
- Biological Resources (including Fish, Wildlife, and Plants)
- Climate
- Coastal Resources
- Department of Transportation Act, Section 4(f) Resources
- Farmlands
- Hazardous Materials, Solid Waste, and Pollution Prevention
- Historical, Architectural, Archaeological, and Cultural Resources
- Land Use
- Natural Resources and Energy Supply
- Noise and Compatible Land Use
- Socioeconomic, Environmental Justice, and Children’s Environmental Health and Safety Risks
- Visual Effects (Light Emissions)
- Water Resources (including Wetlands, Floodplains, Surface Waters, Groundwater, and Wild and Scenic Rivers)

For each of the resources covered in this section, the following information is provided:

- Regulatory Setting
- Affected Environment
- Environmental Consequences

3.1 Resources Not Analyzed in Detail

This EA does not analyze potential impacts on the following environmental impact categories in detail, for the reasons explained below:

- **Air Quality and Climate** – The drone is battery-powered will not generate emissions that could result in air quality impacts or climate impacts. Electricity consumed for battery charging at the nest and for overall nest operation will be minimal, especially for the limited scope of these operations. Electricity consumed for the proposed action will come from the power grid, with an

emergency generator at the nest location for backup. Electricity usage is not expected to be significant.

- **Coastal Resources** –The proposed operation would not directly affect any shorelines, change the use of shoreline zones, or be inconsistent with any NOAA-approved state Coastal Zone Management Plan (CZMP) since there are no coastal zones or shorelines in the area of operations.
- **Farmlands** –The proposed action will not involve the development or disturbance of any land regardless of use, nor would it have the potential to convert any farmland to non-agricultural uses.
- **Hazardous Materials, Solid Waste, and Pollution Prevention** –The proposed action will not result in any construction or development or any physical disturbances of the ground. Therefore, the potential for impact in relation to hazardous materials, pollution prevention, and solid waste is not anticipated. Additionally, each Zip drone is made from recoverable materials and will be properly managed at the end of its operating life in accordance with 14 CFR Part 43.
- **Land Use** – The proposed action will not involve any changes to existing, planned, or future land uses within the area of operations.
- **Natural Resources and Energy Supply** – The proposed action will not require the need for unusual natural resources and materials, or those in short supply. Zipline’s aircraft will be battery powered and will not consume fuel resources.
- **Socioeconomic Impacts and Children’s Environmental Health and Safety Risks** – The proposed action will not involve acquisition of real estate, relocation of residents or community businesses, disruption of local traffic patterns, loss in community tax base, or changes to the fabric of the community. Executive Order (EO) 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, requires federal agencies to ensure that children do not suffer disproportionately from environmental or safety risks. The proposed action will not affect products or substances that a child would be likely to come into contact with, ingest, use, or be exposed to, and would not result in environmental health and safety risks that could disproportionately affect children. Additionally, Zipline’s proposal includes avoiding operations near schools (Monday – Friday) and playgrounds during operational hours, which could help reduce any potential environmental health or safety impacts to children.
- **Visual Effects (Light Emissions Only)** – The proposed action will not result in significant light emission impacts because flights will be limited to daytime flights only.
- **Water Resources (Wetlands, Floodplains, Groundwater, and Wild and Scenic Rivers)** –The proposed operation will not result in the construction of facilities and would therefore not encroach upon areas designated as navigable waters or directly impact wetlands. The proposed operation will not encroach upon areas designated as a 100-year flood event area as described by the Federal Emergency Management Agency (FEMA). The proposed action will not result in any changes to existing discharges to water bodies, create a new discharge that would result in impacts to surface waters, or modify a water body. The proposed action does not involve land acquisition or ground disturbing activities that would withdraw groundwater from underground aquifers or reduce infiltration or recharge to ground water resources through the introduction of new impervious surfaces. The proposed action would not foreclose or downgrade the Wild,

Scenic, or Recreational river status of a river or river segment included in the Wild and Scenic River System. There are no listed river segments within the operational area.

3.2 Biological Resources (Including Fish, Wildlife and Plants)

3.2.1 Regulatory Setting

Biological resources include plant and animal species and their habitats, including special status species (federally listed or state-listed threatened or endangered species, species proposed for listing, species that are candidates for federal listing, marine mammals, and migratory birds) and environmentally sensitive or critical habitat. Biological resources provide aesthetic, recreational, and economic benefits to society.

Threatened and Endangered Species

The Endangered Species Act (ESA) of 1973 [16 U.S.C. § 1531 et seq.] requires the evaluation of all federal actions to determine whether a proposed action is likely to jeopardize any proposed, threatened, or endangered species or proposed or designated critical habitat. Critical habitat includes areas that will contribute to the recovery or survival of a listed species. Federal agencies are responsible for determining if an action “may affect” listed species, which determines whether formal or informal consultation with the U.S. Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Service (NMFS) is needed. If the FAA determines that the action will have no effect on listed species, consultation is not required. If the FAA determines that the action may affect listed species, consultation with the USFWS must be initiated.

A significant impact to federally-listed threatened and endangered species would occur when the USFWS or NMFS determines that the proposed action would be likely to jeopardize the continued existence of a federally-listed threatened or endangered species, or would be likely to result in the destruction or adverse modification of federally-designated critical habitat. An action need not involve a threat of extinction to federally listed species to meet the NEPA standard of significance. Lesser impacts including impacts on non-listed or special status species could also constitute a significant impact.

Migratory Birds

The Migratory Bird Treaty Act (16 U.S.C. §§ 703-712) protects migratory birds, including their nests, eggs, and parts, from possession, sale, purchase, barter, transport, import, export, and take. The USFWS is the federal agency responsible for the management of migratory birds as they spend time in habitats of the U.S. For purposes of the Migratory Bird Treaty Act, “take” is defined as “to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect” (50 CFR § 10.12). The Migratory Bird Treaty Act applies to migratory birds identified in 50 CFR § 10.13 (defined hereafter as “migratory birds”).

Bald and Golden Eagles

The Bald and Golden Eagle Protection Act prohibits anyone from “taking” a bald or golden eagle, including their parts, nests, or eggs, without a permit issued by the USFWS. Implementing regulations (50 CFR § 22), and USFWS guidelines as published in the National Bald Eagle Management Guidelines, provide for additional protections against “disturbances.” Similar to take, “Disturb” means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, injury to an eagle or causes either a decrease in its productivity or nest abandonment due to a substantial interference with breeding, feeding, or sheltering. A permitting process provides limited exceptions to the Bald and Golden Eagle Protection Act’s prohibitions. The USFWS has issued regulations for the permitting process

in 50 CFR § 22. The National Bald Eagle Management Guidelines state that aircraft should remain at least 1,000 feet from known bald eagle nests during the breeding season unless operated by a trained wildlife biologist.

3.2.2 Affected Environment

This section describes the existing biological environment of the operating area. The operating area north of Charlotte is in the Southern Outer Piedmont ecoregion of North Carolina, characterized by relatively low, gentle hills, with a mix of forest and cleared land.¹⁰

The proposed action would take place over rural, suburban, and commercially-developed properties. These areas provide habitat for many of the more common and ubiquitous bird and mammal species of the southern U.S., including mammals such as white tailed deer, raccoons, opossums, and squirrels, and many volant organisms including bats, songbirds, waterfowl and insects.

Special Status Species

Federally Listed Species

The potential for impacts to federally-listed species was assessed using the USFWS Information for Planning and Consultation (IPaC) map tool and reports. The study area covered the entire operating area, outlined in yellow in Figure 1 of this EA. The IPaC report is included as Appendix A.

Based on the IPaC report, there are no ESA-listed bird species in the study area. The Northern Long-eared Bat (*Myotis septentrionalis*), a threatened bat species, is listed in the IPaC report as potentially occurring in the operating area. The Monarch Butterfly (*Danaus plexippus*) is a candidate for federal listing and could occur in the operating area. There is no critical habitat within the operating area for any species identified in the IPaC report.

State Species of Concern

The North Carolina Wildlife Resources Commission (the Commission) lists 248 species of amphibians, birds, fish, mammals, reptiles, and mollusks as endangered, threatened, or of special concern within the State of North Carolina.¹¹ The majority of these species do not occur in the operating area because it is located outside their range and/or suitable habitat is not present in the operating area. Of the 248 species listed by the Commission, the FAA identified 18 species as having the potential to occur within the operating area for at least part of the year. These species are identified in Table 3-1 below.

Table 3-1 North Carolina State Species of Concern

Status	Species Name
State Endangered (Birds)	American peregrine falcon (<i>Falco peregrinus anatum</i>)
State Threatened (Birds)	Bald eagle (<i>Haliaeetus leucocephalus</i>)
	Northern saw-whet owl (<i>Aegolius acadicus</i>)
State Special Concern (Birds)	Bachman's sparrow (<i>Peucaea aestivalis</i>)
	Barn Owl (<i>Tyto alba</i>)
	Brown creeper (<i>Certhia americana nigrescens</i>)
	Cerulean warbler (<i>Setophaga cerulea</i>)

¹⁰ North Carolina Wildlife Resources Commission. 2015 Wildlife Action Plan. Available: <https://www.ncwildlife.org/plan#6718619-2015-document-downloads>. Accessed: December 13, 2021.

¹¹ North Carolina Wildlife Resources Commission. Protected Wildlife Species of North Carolina. Available: <https://www.ncwildlife.org/Portals/0/Conserving/documents/Protected-Wildlife-Species-of-NC.pdf>. Accessed: January 3, 2022.

	Golden-winged warbler (<i>Vermivora chrysoptera</i>)
	Least bittern (<i>Ixobrychus exilis</i>)
	Little blue heron (<i>Egretta caerulea</i>)
	Loggerhead shrike (<i>Lanius ludovicianus</i>)
	Painted bunting (<i>Passerina ciris</i>)
	Vesper sparrow (<i>Pooecetes gramineus</i>)
State Species of Concern (Mammals)	Buxton Woods white-footed mouse (<i>Peromyscus leucopus buxtoni</i>)
	Eastern big-eared bat (<i>Corynorhinus rafinesquii macrotis</i>)
	Eastern small-footed bat (<i>Myotis leibii leibii</i>)
	Pungo white-footed mouse (<i>Peromyscus leucopus easti</i>)
	Southeastern bat (<i>Myotis austroriparius</i>)

Migratory Birds

Migratory bird species found within the operating area will vary throughout the year. During certain weeks in the spring and fall, hundreds of species of songbirds, raptors, and waterfowl may potentially pass through the operating area. Additionally, several dozen species of birds may potentially nest in the operating area at certain times of the year.

The IPaC report identifies Birds of Conservation Concern (BCC) that could occur in the operating area, along with information on the likelihood that they may be nesting in the area. The Bald Eagle (*Haliaeetus leucocephalus*) is not a BCC in the operating area; however, it does nest in forested areas near rivers and lakes in the area, and, as stated in the National Bald Eagle Management Guidelines¹², aircraft should stay at least 1,000 feet from Bald Eagle nests during its breeding season unless the aircraft is operated by a trained wildlife biologist.

The Red-headed Woodpecker (*Melanerpes erythrocephalus*) is a BCC within the operating area. Red-headed Woodpeckers typically nest in tall, dead trees near marshes and open bodies of water. It is possible that Red-headed Woodpeckers may be nesting within the operating area.

3.2.3 Environmental Consequences

As discussed in Section 1.2, the Zipline nest is already constructed and in use, therefore there will be no ground construction or habitat modification associated with the proposed action. The aircraft nest is in a developed location adjacent to the Kannapolis Parkway. Zipline's aircraft will not touch the ground in any other place than the nest (except during emergency landings), since it remains aerial while conducting deliveries.

The operations will be taking place within airspace, and typically well above the tree line and away from sensitive habitats. After launch, Zipline's UA will rise to a cruising altitude between 130 feet and 400 feet above ground level (AGL) and follow a preplanned route to its delivery site. The pre-planned route is optimized to avoid terrain and object obstructions, areas of high aircraft traffic, and areas where people may gather in large numbers such as highways, parks, and schools. Aircraft will stay above 130 feet AGL except when descending to drop a package. The aircraft descends into its delivery loop and releases a package from approximately 60 feet AGL. Packages are carried internally in the aircraft's fuselage, and are dropped by opening a set of payload doors on the aircraft. Packages fall under a small parachute,

¹² U.S. Fish and Wildlife Service. 2007. National Bald Eagle Management Guidelines. Available: <https://www.fws.gov/northeast/ecologicalservices/pdf/NationalBaldEagleManagementGuidelines.pdf>. Accessed: October 19, 2021.

which limits terminal velocity, toward the package drop zone at approved delivery sites. The low number of daily operations and nature of the flights are not expected to significantly influence wildlife in the area.

Special Status Species

The federally threatened Northern Long-eared Bat, as well as several state bat species of concern, have the potential to occur within the operating area. While these bat species may occur within the operating area, they are unlikely to encounter the aircraft as Zipline's proposed operations will be limited to daytime hours. In the event that flights do overlap with dawn or dusk bat emergence, bats may exhibit disturbance behaviors and change their flight paths to avoid drones.¹³ However, research also suggests that drones have "minimal impact on bat behavior" and do not appear to be disturbed by drones.¹⁴ As a result, the FAA has made a finding of *no effect* for Northern Long-eared Bats under the Endangered Species Act. The FAA has also determined that the proposed action will cause no significant impacts to state bat species of concern.

The Monarch Butterfly, a candidate for federal listing, has the potential to occur in the operating area. Insects could be struck by drones en route to delivery. Information regarding drone impacts on insects is limited and there have been no widespread negative impacts identified in the scientific literature. Therefore, based on the information available and the limited scale of operations, the action is not expected to have significant impacts to insect populations.

State protected bird species may display disturbance behaviors towards drones, such as fleeing or attack maneuvers; however, due to the limited scale of operations and the altitude of overflights, no impacts to state protected bird species are expected.

Migratory Birds

Zipline has stated to the FAA that it will monitor the operating area for any active Bald Eagle nests that may occur. Bald Eagle nests are typically very conspicuous, usually five to nine feet in diameter, with a vertical depth up to eight feet, and Zipline should be able to visually identify any nests that may be present in the area.¹⁵ Online resources such as iNaturalist may also be used to identify Bald and Golden Eagle nests that may be active in the operating area. If Zipline identifies a Bald Eagle nest or is notified of the presence of a nest by a state regulator or naturalist group, Zipline will establish an avoidance area such that there is a 1,000 feet vertical and horizontal separation distance between the vehicle's flight path and the nest. This avoidance area will be maintained until the end of the breeding season (December 1 through July 15 in North Carolina) or a qualified biologist indicates the nest has been vacated.¹⁶

Red-headed Woodpecker nest locations should not be disturbed during the breeding period (May 10 to September 10)¹⁷ so as to avoid any potential impacts to the nest activity, such as nest abandonment. If Zipline learns of any active Red-headed Woodpecker nests within the operating area, it has indicated it

¹³ Fewer bat passes are detected during small, commercial drone flights. Available: <https://www.nature.com/articles/s41598-021-90905-0>. Accessed: October 21, 2021

¹⁴ Autonomous drones are a viable tool for acoustic bat surveys. Available: <https://www.biorxiv.org/content/10.1101/673772v1.full.pdf>. Accessed: October 21, 2021

¹⁵ USFWS Midwest Region: Identification of Large Nests. Available: https://www.fws.gov/midwest/eagle/Nhistory/nest_id.html. Accessed: December 13, 2021

¹⁶ Step 6 – Eagle Protection. Raleigh Ecological Services Field Office. Available: https://www.fws.gov/raleigh/PR_16.html. Accessed: January 4, 2022.

¹⁷ See IPaC Report in Appendix A of this EA.

would avoid identified nest sites during the breeding season or until a qualified biologist indicates the nest has been vacated.

Due to the limited operating area and proposed number of daily operations, occasional drone overflights between 130-400 feet AGL are not expected to impact critical lifecycles of wildlife species or their ability to survive.

Our analysis finds that the proposed action is not expected to cause any of the following impacts:

- A long-term or permanent loss of unlisted plant or wildlife species, i.e., extirpation of the species from a large project area;
- Adverse impacts to special status species (e.g., state species of concern, species proposed for listing, migratory birds, bald and golden eagles) or their habitats;
- Substantial loss, reduction, degradation, disturbance, or fragmentation of native species' habitats or their populations; or
- Adverse impacts on a species' reproductive success rates, natural mortality rates, non-natural mortality (e.g., road kills and hunting), or ability to sustain the minimum population levels required.

3.3 Department of Transportation Act, Section 4(f) Resources

3.3.1 Regulatory Setting

Section 4(f) of the DOT Act [codified at 49 U.S.C. § 303(c)] protects significant publicly owned parks, recreational areas, wildlife and waterfowl refuges, and public and private historic sites. Section 4(f) states that, subject to exceptions for de minimis impacts¹⁸: “The Secretary may approve a transportation program or project requiring the use of [4(f) resources]...only if—(1) there is no prudent and feasible alternative to using that land; and (2) the program or project includes all possible planning to minimize harm to the park, recreation area, wildlife and waterfowl refuge, or historic site resulting from the use.”

The term “use” includes both direct or physical and indirect or “constructive” impacts to Section 4(f) resources. Direct use is the physical occupation or alteration of a Section 4(f) property or any portion of a Section 4(f) property. A constructive use does not require direct physical impacts or occupation of a Section 4(f) resource. A constructive use would occur when a proposed action would result in substantial impairment of a resource to the degree that the protected activities, features, or attributes of the resource that contribute to its significance or enjoyment are substantially diminished. The determination of use must consider the entire property and not simply the portion of the property used for a proposed project.¹⁹

Section 4(f) resources where a quiet setting is a generally recognized feature or attribute receive special consideration. In assessing constructive use, FAA Order 1050.1F, Appendix B, page B-11, requires that

¹⁸ The FAA may make a de minimis impact determination with respect to a physical use of Section 4(f) property if, after taking into account any measures to minimize harm, the result is either: (1) a determination that the project would not adversely affect the activities, features, or attributes qualifying a park, recreation area, or wildlife or waterfowl refuge for protection under Section 4(f); or (2) a Section 106 finding of no adverse effect or no historic properties affected. See 1050.1F Desk Reference, Paragraph 5.3.3

¹⁹ Federal Highway Administration (FHWA) Section 4(f) Policy Paper. (Note: FHWA regulations are not binding on the FAA; however, the FAA may use them as guidance to the extent relevant to aviation projects.) Available: <https://www.environment.fhwa.dot.gov/legislation/section4f/4fpolicy.pdf>. Accessed: February 2, 2021

the FAA “...must consult all appropriate federal, state, and local officials having jurisdiction over the affected Section 4(f) properties when determining whether project-related impacts would substantially impair the resources.” Parks, recreation areas, and wildlife and waterfowl refuges that are privately owned are not subject to Section 4(f) provisions.

A significant impact would occur pursuant to NEPA when a proposed action either involves more than a minimal physical use of a section 4(f) property or is deemed a "constructive use" based on an FAA determination that the proposed action would substantially impair the 4(f) property, and mitigation measures do not eliminate or reduce the effects of the use below the threshold of significance.

3.3.2 Affected Environment

The FAA identified many properties that could meet the definition of a Section 4(f) resource within the operating area, including public parks, historic sites, and wildlife refuges. Some Section 4(f) resources in the operating area include Lake Norman State Park, Cowans Ford Wildlife Refuge, Auten Nature Reserve, and Latta Nature Reserve.

There are several historic sites within the operating area as listed on the North Carolina State Historic Preservation Office (SHPO) website; however, most of these are considered for architectural or other purposes that will not typically be affected by UA operations. Also, as discussed in Section 3.4, Historical, Architectural, Archaeological, and Cultural Resources, the FAA has previously consulted with the North Carolina SHPO for Zipline’s COVID-19 route approvals to determine whether historic and traditional cultural properties would be affected by the proposed action, and support the FAA’s determination that the proposed UA operations will have no potential to affect historic properties.

3.3.3 Environmental Consequences

There will be no physical use of Section 4(f) resources because there will be no construction on any Section 4(f) resource. The FAA has determined that infrequent UAS overflights as described in the proposed action are not considered a constructive use of any Section 4(f) resource, and will not cause substantial impairment to any of the Section 4(f) resources in the operating area. As described in the Section 3.5, Noise and Noise-Compatible Land Use, and the Noise Analysis Report (Appendix C), the proposed operations will not result in significant noise levels at any location in the operating area. Noise and visual effects from Zipline’s occasional overflights are not expected to diminish the activities, features, or attributes of the resources that contribute to their significance or enjoyment.

Additionally, Zipline identifies properties such as public parks and wildlife and waterfowl refuges in its flight planning system. Areas where open air gatherings of people typically occur, such as open air concert venues and school yards, will also be avoided through the use of Zipline’s route planning software, which prepares an optimized flight path from the nest to each designated delivery site. The software ensures that each route integrates and respects all of the restrictions entered into the database, and that Section 4(f) properties can be automatically avoided based on the type of the resource, time of day, and other factors. The FAA has determined that there will be no significant impacts to Section 4(f) resources as a result of the proposed action.

3.4 Historical, Architectural, Archaeological, and Cultural Resources

3.4.1 Regulatory Setting

Section 106 of the National Historic Preservation Act (NHPA) of 1966 [54 U.S.C. § 306108] requires federal agencies to consider the effects of their undertakings on properties listed or eligible for listing in

the National Register of Historic Places (NRHP). This includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization that meets the NRHP criteria. Regulations related to this process are contained in 36 CFR Part 800, Protection of Historic Properties. Compliance with Section 106 requires consultation with the State Historic Preservation Officer (SHPO) and applicable other parties, including Indian tribes.

Major steps in the Section 106 process include identifying the Area of Potential Effects (APE), identifying historic and cultural resources within the APE, consulting with the SHPO and any Tribal Historic Preservation Office (THPO) that is identified as potentially having traditional cultural interests in the area, and determining the potential impacts to historic properties as a result of the action.

The FAA has not established a significance threshold for this impact category; however, the FAA has identified a factor to consider when evaluating the context and intensity of potential environmental impacts for historical, architectural, archeological, and cultural resources. A factor to consider in assessing significant impact is when an action would result in a finding of adverse effect through the Section 106 process. However, under 36 CFR § 800.8(a), a finding of adverse effect on a historic property does not necessarily result in a significance finding under NEPA.

3.4.2 Affected Environment

The APE for the proposed action is the entire operating area where Zipline is planning to conduct UA package deliveries, as shown in Figure 1 in this EA. The FAA identified historic sites that were listed on the North Carolina SHPO website.²⁰

Prior to Zipline's COVID-19 route approvals in 2020, the FAA twice conducted historic and cultural outreach in accordance with 36 CFR § 800.4(a)(1). In May 2020, the FAA consulted with the SHPO and the Catawba Indian Nation THPO for operations on four routes that were flown in response to the COVID-19 pandemic from the Kannapolis nest location.²¹ On May 28, 2020, the FAA received a "No Objection" response from the Catawba Indian Nation THPO, and on May 29, 2020, the FAA received a "No Objection" response from the NC SHPO.

In August 2020, the FAA consulted again with the North Carolina SHPO and with the Catawba Indian Nation for amendments and extensions of the routes from the Kannapolis nest. The FAA received a "No Objection" response from the NC SHPO in August 2020. The FAA's tribal and historic outreach letters are included as Appendix B.

While the SHPO and THPO outreach that the FAA conducted in 2020 was for specific routes from the Kannapolis nest instead of a broader area approval, the UA flight characteristics and approximate number of operations will not be significantly different under the proposed action that is the subject of this EA; however, there will be more routes as Zipline conducts operations to approved delivery locations in 16 communities across the operating area.

3.4.2 Environmental Consequences

The nature of UA effects on historic properties is limited to non-physical, reversible impacts (i.e., the introduction of audible and/or visual elements). The limited number of daily flights that Zipline is

²⁰ North Carolina State Historic Preservation Office GIS Web Service. Available: <https://nc.maps.arcgis.com/apps/webappviewer/index.html?id=79ea671ebdcc45639f0860257d5f5ed7>. Accessed: June 14, 2021.

²¹ FAA utilized the Housing and Urban Development (HUD) Tribal Directory Assessment Tool (TDAT) to identify tribes with ancestral ties or other interests within the Concord Network Area of Operations.

proposing – initially 20 delivery operations per day in the first year of operations from the Kannapolis nest - means that any historic or cultural resource would be subject to only a small number of overflights per day, if any.

Additionally, the FAA's noise exposure analysis for the proposed action concluded that noise levels would not exceed DNL 45 dB in any location within the study area other than the nest property. Based on a review of the information available, and the FAA's knowledge with respect to the level of environmental impacts from UAS operations, the FAA has determined that this undertaking will have no potential to effect historic properties, in accordance with 36 CFR § 800.3(a)(1). Additionally, there would be no known effect on known cultural resources from this action.

3.5 Noise and Noise-Compatible Land Use

3.5.1 Regulatory Setting

Aircraft noise is often the most noticeable environmental effect associated with any aviation project. Several federal laws, including the Aviation Safety and Noise Abatement Act of 1979, as amended (49 U.S.C. §§ 47501-47507) regulate aircraft noise. Through 14 CFR Part 36, the FAA regulates noise from aircraft.

FAA Order 1050.1F, Appendix B, Paragraph B-1.3 requires the FAA to identify the location and number of noise sensitive areas that could be significantly impacted by noise. As defined in Paragraph 11-5b of Order 1050.1F, page 11-3, a noise sensitive area is "[a]n area where noise interferes with normal activities associated with its use. Normally, noise sensitive areas include residential, educational, health, and religious structures and sites, and parks, recreational areas, areas with wilderness characteristics, wildlife refuges, and cultural and historical sites."

Sound is measured in terms of the decibel (dB), which is the ratio between the sound pressure of the sound source and 20 micropascals, which is nominally the threshold of human hearing. Various weighting schemes have been developed to collapse a frequency spectrum into a single dB value. The A-weighted decibel, or dBA, corresponds to human hearing accounting for the higher sensitivity in the mid-range frequencies.

To comply with NEPA requirements, the FAA has issued requirements for assessing aircraft noise in FAA Order 1050.1F, Appendix B. FAA's primary noise metric for aviation noise analysis is the yearly Day-Night Average Sound Level (DNL) metric. The DNL metric is a single value representing the logarithmically average aircraft sound level at a location over a 24-hour period, with a 10 dB adjustment added to those noise events occurring from 10:00 p.m. and up to 7:00 a.m. the following morning. A significant noise impact is defined in Order 1050.1F as an increase in noise of DNL 1.5 dB or more at or above 65 dB DNL noise exposure or a noise exposure at or above the 65 dB level due to a DNL 1.5 dB or greater increase.

3.5.2 Affected Environment

The study area is approximately 257 square miles, and the estimated population within the area is roughly 160,000. The population density is approximately 631 persons per square mile.²²

²² Environmental Protection Agency's (EPA) Environmental Justice Screening Tool (EJSCREEN). Available: <https://www.epa.gov/ejscreen>. Accessed: November 24, 2021

Additionally, 24 airports and six helipads fall within the study area, as shown on Figure 1. Due to the expected avoidance between the proposed UA activity and other aviation activity, existing aircraft noise within the study area is not expected to be a contributing factor to the assessment of UA noise.

3.5.3 Environmental Consequences

Human perception of noise depends on a number of factors, including overall noise level, number of noise events, the extent of audibility above the background ambient noise level, and acoustic frequency content (pitch). UA noise generally has high acoustic frequency content, which can often be more discernable from other typical noise sources.

To ensure that noise would not cause a significant impact to any residential land use or noise sensitive resource within the study area, the FAA initiated an analysis of the potential noise exposure in the area that could result from implementation of the proposed action. Away from the actual nest property, the neighborhood across the Kannapolis Parkway from nest location is likely to experience the highest noise levels as a result of the proposed action. This is due to noise from the catapult launch system, and the lower altitudes that the UA will be flying in this location during launch and recovery.

Noise Exposure

Utilizing the operational projections defined in Sections 1 and 2, the noise analysis methodology detailed in Appendix C was then used to estimate DNL levels for the proposed Zipline Kannapolis operations. Noise levels were calculated for each flight phase and are presented in the following three sub-sections:

- Noise Exposure for Nest Operations
- Noise Exposure for En-route Operations
- Noise Exposure for Delivery Operations

Noise Exposure for Nest Operations

Based on the anticipated average daily maximum number of deliveries provided by Zipline, the extent of DNL 45 dB associated with nest operations is shown in Figure 4. This region was determined based on a review of the layout of the Kannapolis nest location including the orientation of launch and recovery equipment and using the noise level information presented in referencing Tables 2 and 3 of Appendix C.

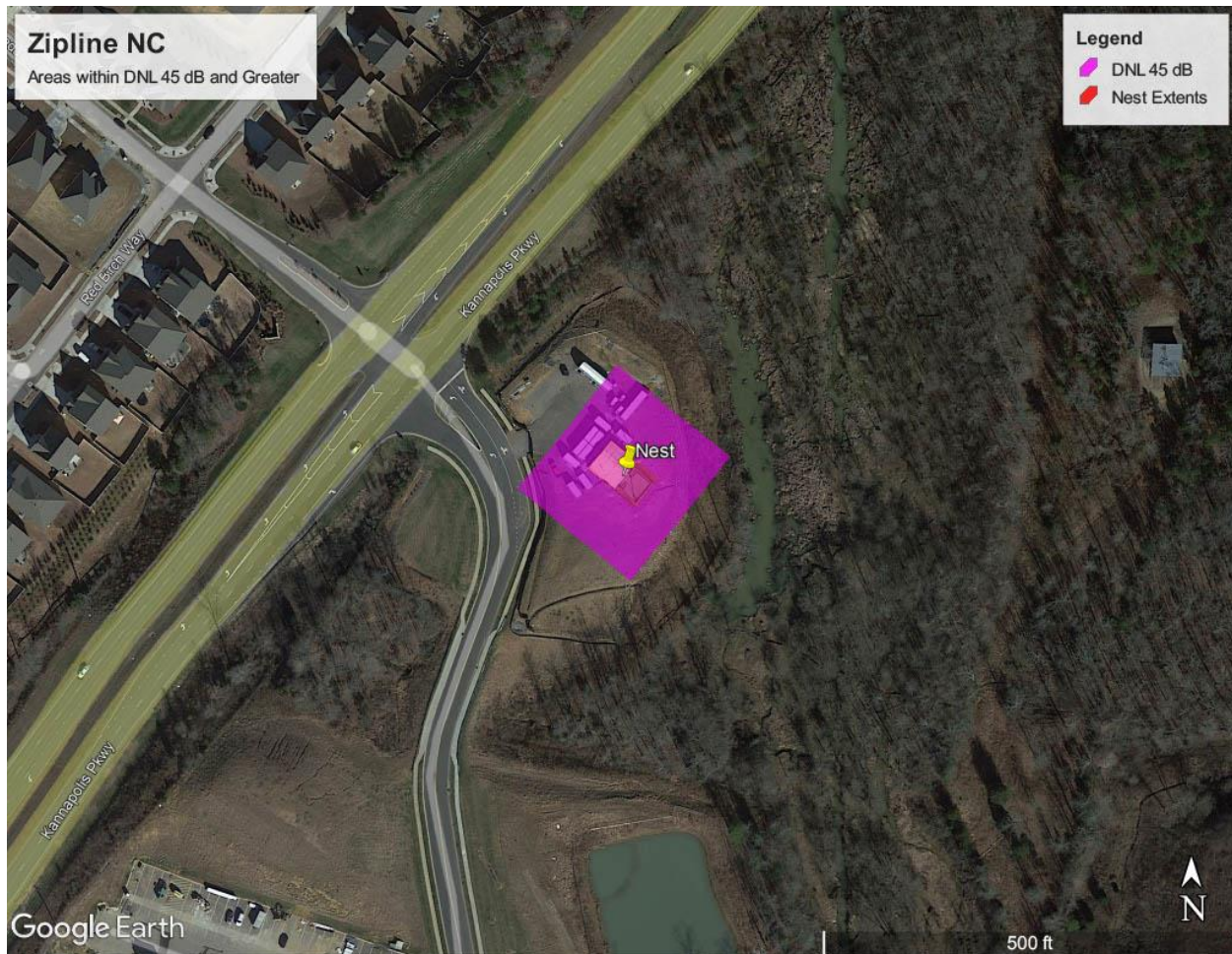


Figure 4 DNL 45 dB or greater noise exposure at Kannapolis nest location

Noise Exposure for En-route Operations

Based on the information provided by Zipline, it is anticipated that the UA will cruise at altitudes between 130 to 400 feet AGL at an airspeed of 50-56 knots during en-route flight. However to provide a conservative estimate for en-route noise exposure, the noise exposure was calculated assuming operations at 250 feet AGL and at an airspeed of 40 knots. The en-route noise exposure can be determined by referencing Table 4 of Appendix C. This analysis shows that en-route noise levels would not exceed DNL 45dB in any location within the study area.

Noise Exposure for Delivery Operations

Due to the inherent uncertainty of the exact delivery site locations and characteristics, the noise analysis assumes that all deliveries will occur at a single delivery location within each delivery community in order to provide a conservative estimate of potential delivery noise exposure. Assuming Zipline's projected maximum number of 20 delivery flight operations per day (7,300 annual operations), distributed evenly over the 16 anticipated delivery communities shown on Table 2-1; an average of 1.25 daily deliveries to each community (approximately 456 annual deliveries) is expected. A conservative estimate of delivery noise exposure can then be determined by referencing Table 6 of Appendix C. This analysis shows that delivery noise levels would not exceed DNL 45dB in any of the communities Zipline where anticipates providing deliveries.

Total Noise Exposure Results

The maximum noise exposure levels within the study area will occur at the nest site; where noise levels at the or above DNL 45 dB would extend 50 feet to the southwest and northeast extents of the Kannapolis nest, and 25 feet to the northwest and southeast of the nest, respectively. Based on these dimensions, the DNL 45 dB would remain almost entirely within the vicinity of the nest infrastructure on the Stewart-Haas Racing campus property and is well below the threshold of DNL 65 dB for compatible land use. Additionally, the estimated noise exposure for en-route and delivery operations at locations away from the Kannapolis Nest would not exceed DNL 45dB at any location within the study area.

3.6 Environmental Justice

3.6.1 Regulatory Setting

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*, Section 1-101 requires all federal agencies to the greatest extent practicable and permitted by law, to make achieving environmental justice part of its mission by identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

The DOT Order 5610.2(a) defines minority as “individuals who are Black; Hispanic or Latino; Asian American; American Indian and Alaskan Native; Native Hawaiian and other Pacific Islander”. A minority population is any readily identifiable group of minority persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed DOT program, policy, or activity.

The DOT Order 5610.2(a) defines a low-income person as a person whose median household income is at or below the Department of Health and Human Services poverty guidelines. A low-income population is any readily identifiable group of low-income persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed DOT program, policy, or activity.

FAA Order 1050.1F provides guidance for the preparation of environmental justice analysis in support of an EA. Section 4-3.3, Exhibit 4-1 of the Order indicates that FAA should consider whether the action would have the potential to lead to a disproportionately high and adverse impact, i.e., a low-income or minority population, due to: significant impacts in other environmental impact categories; or impacts on the physical or natural environment that affect an environmental justice population in a way that the FAA determines are unique to the environmental justice population and significant to that population. If a significant impact would affect low income or minority populations at a disproportionately higher level than it would other population segments, an environmental justice issue is likely.

A disproportionately high and adverse effect on minority or low-income populations means an adverse effect that:

1. Is predominately borne by a minority population and/or a low-income population; or
2. Will be suffered by the minority population and/or low-income population and is appreciable more severe or greater in magnitude than adverse effects that will be suffered by the non-minority population and/or low-income population.

The FAA has not established a significance threshold for environmental justice. In assessing significance, FAA considers the following factors: (1) significant impacts in other environmental impact categories; or (2) impacts on the physical or natural environment that affect an environmental justice population in a way that the FAA determines are unique to the environmental justice population and significant to that population.

3.6.2 Affected Environment

Based on the EJSCREEN report prepared for the proposed action (Appendix D), approximately 33 percent of the population within the operating area would be considered low-income, as compared to 36 percent of the population for the entire state. Approximately 48 percent of the population in the area would be considered a person of color, as compared to 37 percent of the population for the entire state. The FAA also looked at race and ethnicity census data for Charlotte City, North Carolina, which is the larger metropolitan area that the operating area is located in. Using this census data, the FAA determined that the minority population is approximately 49 percent.²³ Comparing the minority population in the operating area to the minority population in Charlotte City, the minority population is lower in the operating area.

While there are minority and low-income populations in the operating area, because the percentage of the minority populations are below the Charlotte City population and the low income population is below that for North Carolina, the FAA has determined that operating area does not contain an EJ community.

3.6.3 Environmental Consequences

The proposed action would not result in adverse impacts in any environmental resource category. As noted in Section 3.5, *Noise and Noise-Compatible Land Use*, and the Noise Analysis Report in Appendix C, the drone's noise emissions could be perceptible in areas within the operating area, but will stay well below the level determined to constitute a significant impact. Since the proposed action would not result in effects that would be predominately born by an EJ population, the FAA determined it would not result in an adverse effect on a low-income or a minority population.

3.7 Visual Effects (Visual Resources and Visual Character)

3.7.1 Regulatory Setting

Visual resources and visual character impacts deal with the extent to which the proposed action would result in visual impacts to resources in the operating area. Visual impacts can be difficult to define and evaluate because the analysis is generally subjective, but are normally related to the extent that the proposed action would contrast with, or detract from, the visual resources and/or the visual character of the existing environment. In this case, visual effects would be limited to the introduction of a visual intrusion – a UA in flight – which could be out of character with the suburban or natural landscapes.

The FAA has not developed a visual effects threshold of significance similar to noise impacts. Factors FAA considers in assessing significant impacts include the degree to which the action would have the potential to: (1) affect the nature of the visual character of the area, including the importance, uniqueness, and aesthetic value of the affected visual resources; (2) contrast with the visual resources

²³ U.S. Census Bureau. Available: <https://www.census.gov/quickfacts/fact/table/charlottecitynorthcarolina/IPE120220#IPE120220>. Accessed: January 6, 2022.

and/or visual character in the study area; or (3) block or obstruct the views of visual resources, including whether these resources would still be viewable from other locations.

3.7.2 Affected Environment

The proposed action would take place over mostly suburban and commercially-developed properties. As noted in Section 3.3, *DOT Act Section 4(f) Resources*, there are some public parks, historic properties, and wildlife refuges that could be valued for aesthetic attributes within the study area. However, Zipline’s proposal is to avoid overflights of these “no fly” areas during the scope of the proposed action. The Kannapolis nest is on private property at the Stewart-Haas Racing campus and cannot be viewed from beyond the property. The FAA estimates that at typical operating altitude and speeds the UA en-route would be observable for approximately six seconds by an observer on the ground.

3.7.3 Environmental Consequences

The proposed action makes no changes to any landforms, or land uses, thus there would be no effect to the visual character of the area. The proposed action involves airspace operations that could result in visual impacts on sensitive areas such as Section 4(f) properties where the visual setting is an important resource of the property. However, the short duration that each drone flight could be seen from any resource in the operating area, approximately six seconds in total, and the low number of proposed flights per day, would minimize any potential for significant visual impacts. Any visual effects are expected to be similar to existing air traffic in the vicinity of the operating area.

3.8 Water Resources (Surface Waters)

3.8.1 Regulatory Setting

Surface water resources generally consist of oceans, wetlands, lakes, rivers, and streams. Surface water is important for its contribution to the economic, ecological, recreational, and human health of a community. The Clean Water Act established the National Pollutant Discharge Elimination System (NPDES) program, which regulates the discharge of point sources of water pollution into waters of the United States and requires a permit under Section 402 of the Clean Water Act. Waters of the United States are defined by the Clean Water Act and are protected by various regulations and permitting programs administered by the EPA and the U.S. Army Corps of Engineers. An action would be considered significant to surface waters when it would: (1) exceed water quality standards established by federal, state, local, and tribal regulatory agencies; or (2) contaminate public drinking water supply such that public health may be adversely affected.

3.8.2 Affected Environment

Approximately three square miles of surface waters occur within the operating area, or approximately one percent of the area, based on the EJSCREEN report for this proposed action (Appendix D). Surface waters include Lake Norman and the Don T. Howell Reservoir, in addition to rivers and tributary streams that are also protected by the Clean Water Act.

3.8.3 Environmental Consequences

Zipline has conducted thousands of UAS flight operations, and the FAA does not anticipate any accidents or incidents under the proposed action. While it is highly unlikely for one of Zipline’s aircraft to crash, and even less likely for a crash to happen within a surface water, this EA considers the potential effects of a drone crashing into surface waters covered by the Clean Water Act.

Zipline is a certificated air carrier and complies with all applicable regulatory requirements. This includes compliance with requirements to notify the FAA and/or National Transportation Safety Board (NTSB) in accordance with regulatory requirements in the event of an aircraft accident. Zipline's FAA-accepted checklists include procedures to notify local emergency services in the event of an accident or incident. In accordance with 14 CFR Part 135.23(d), Zipline is required to locate and secure any downed aircraft pending guidance from the FAA or NTSB.

In the event of an in-flight malfunction or deviation, the RPIC can initiate three commands: initiate a hold pattern, return to the nest, or terminate the flight via the emergency parachute system, which may also automatically deploy if the Zip detects a critical failure necessitating a flight termination. In addition, the Lithium-ion battery packs are well-secured within the aircraft, and are not expected to detach from the aircraft or become lost in the event of an incident.

There will be no construction activities associated with the proposed action. The proposed action would not have the potential to adversely affect natural and beneficial water resource values to a degree that substantially diminishes or destroys such values, or to adversely affect surface waters such that the beneficial uses and values of such waters are appreciably diminished or can no longer be maintained and such impairment cannot be avoided or satisfactorily mitigated. Therefore, the potential for impacts to surface waters is not significant.

4.0 LIST OF PREPARERS and CONTRIBUTORS

Table 4-1 lists the principal preparers, reviewers, and contributors to this EA.

Table 4-1. List of Preparers and Contributors

Name and Affiliation	Years of Industry Experience	EA Responsibility
Mike Millard, Flight Standards, FAA Aviation Safety	40	Flight Standards Environmental Specialist and Document Review
Christopher Couture, FAA Aviation Safety	15	Program Management, Environmental Science, and Document Review
Shawna Barry, FAA Office of Environment and Energy	15	NEPA SME, Biological Resources, and Document Review
Sean Doyle, FAA Office of Environment and Energy	16	Noise Analysis and Document Review
Contractor Contributors		
Jodi Jones, FAA Aviation Safety, Marton Technologies, Inc.	12	NEPA SME, Research, and Document Review
Brad Thompson, FAA Aviation Safety, Science Applications International Corporation (SAIC)	7	NEPA SME, Research, and Document Review

5.0 LIST of AGENCIES CONSULTED

State Agencies

North Carolina Department of Natural and Cultural Resources

Tribes

Catawba Indian Nation

Appendix A
IPaC Report

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

North Carolina



Local office

Asheville Ecological Services Field Office

☎ (828) 258-3939

📠 (828) 258-5330

160 Zillicoa Street
Asheville, NC 28801-1082

<http://www.fws.gov/nc-es/es/countyfr.html>

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species¹ and their critical habitats are managed by the [Ecological Services Program](#) of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries²).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact [NOAA Fisheries](#) for [species under their jurisdiction](#).

1. Species listed under the [Endangered Species Act](#) are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the [listing status page](#) for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. [NOAA Fisheries](#), also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME

STATUS

Northern Long-eared Bat *Myotis septentrionalis***Threatened**

Wherever found

No critical habitat has been designated for this species.

<http://ecos.fws.gov/ecp/species/9045>

Reptiles

NAME

STATUS

Bog Turtle *Clemmys muhlenbergii***SAT**

No critical habitat has been designated for this species.

<http://ecos.fws.gov/ecp/species/6962>

Clams

NAME

STATUS

Carolina Heelsplitter *Lasmigona decorata***Endangered**

Wherever found

There is **no** critical habitat for this species. The location of the critical habitat is not available.<http://ecos.fws.gov/ecp/species/3534>

Insects

NAME

STATUS

Monarch Butterfly *Danaus plexippus***Candidate**

Wherever found

No critical habitat has been designated for this species.

<http://ecos.fws.gov/ecp/species/9743>

Flowering Plants

NAME

STATUS

Dwarf-flowered Heartleaf *Hexastylis naniflora***Threatened**

Wherever found

No critical habitat has been designated for this species.

<http://ecos.fws.gov/ecp/species/2458>**Michaux's Sumac** *Rhus michauxii***Endangered**

Wherever found

No critical habitat has been designated for this species.

<http://ecos.fws.gov/ecp/species/5217>**Schweinitz's Sunflower** *Helianthus schweinitzii***Endangered**

Wherever found

No critical habitat has been designated for this species.

<http://ecos.fws.gov/ecp/species/3849>

Smooth Cone flower *Echinacea laevigata*

Endangered

Wherever found

No critical habitat has been designated for this species.

<http://ecos.fws.gov/ecp/species/3473>

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act¹ and the Bald and Golden Eagle Protection Act².

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described [below](#).

1. The [Migratory Birds Treaty Act](#) of 1918.
2. The [Bald and Golden Eagle Protection Act](#) of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern <http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php>
- Measures for avoiding and minimizing impacts to birds <http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php>
- Nationwide conservation measures for birds <http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf>

The birds listed below are birds of particular concern either because they occur on the [USFWS Birds of Conservation Concern](#) (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ [below](#). This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the [E-bird data mapping tool](#) (Tip: enter your location, desired date range and a species on your list). For projects that occur on the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found [below](#).

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME

BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)

Bald Eagle *Haliaeetus leucocephalus*

Breeds Sep 1 to Jul 31

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

<http://ecos.fws.gov/ecp/species/1626>

Black-billed Cuckoo *Coccyzus erythrophthalmus*

Breeds May 15 to Oct 10

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

<http://ecos.fws.gov/ecp/species/9399>

Cerulean Warbler *Dendroica cerulea*

Breeds Apr 28 to Jul 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

<http://ecos.fws.gov/ecp/species/2974>

Eastern Whip-poor-will *Antrostomus vociferus*

Breeds May 1 to Aug 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Golden Eagle *Aquila chrysaetos*

Breeds elsewhere

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

<http://ecos.fws.gov/ecp/species/1680>

Kentucky Warbler *Oporornis formosus*

Breeds Apr 20 to Aug 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Prairie Warbler *Dendroica discolor*

Breeds May 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Prothonotary Warbler *Protonotaria citrea*

Breeds Apr 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Red-headed Woodpecker *Melanerpes erythrocephalus*

Breeds May 10 to Sep 10

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Rusty Blackbird *Euphagus carolinus*

Breeds elsewhere

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Wood Thrush *Hylocichla mustelina*

Breeds May 10 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence

across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is $0.25/0.25 = 1$; at week 20 it is $0.05/0.25 = 0.2$.

3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)

Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)

Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

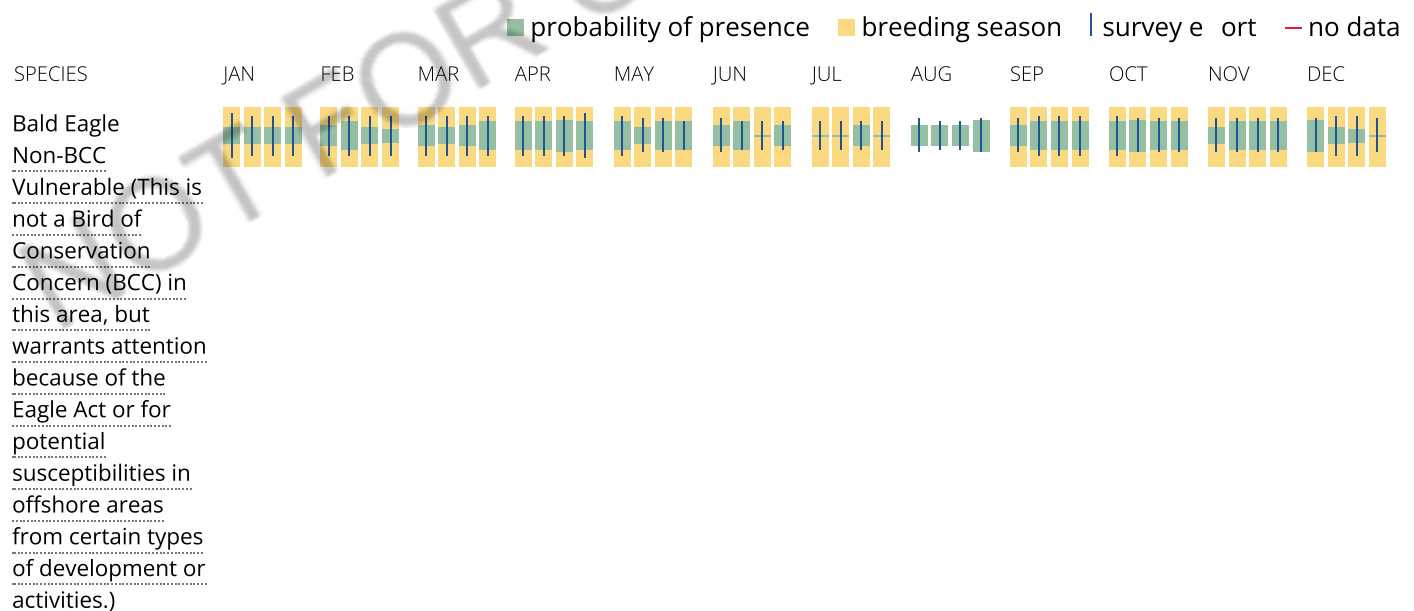
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (—)

A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.





Prairie Warbler
BCC Rangewide
(CON) (This is a
Bird of
Conservation
Concern (BCC)
throughout its
range in the
continental USA
and Alaska.)



Prothonotary
Warbler
BCC Rangewide
(CON) (This is a
Bird of
Conservation
Concern (BCC)
throughout its
range in the
continental USA
and Alaska.)



Red-headed
Woodpecker
BCC Rangewide
(CON) (This is a
Bird of
Conservation
Concern (BCC)
throughout its
range in the
continental USA
and Alaska.)



Rusty Blackbird
BCC - BCR (This is a
Bird of
Conservation
Concern (BCC) only
in particular Bird
Conservation
Regions (BCRs) in
the continental
USA)



Wood Thrush
BCC Rangewide
(CON) (This is a
Bird of
Conservation
Concern (BCC)
throughout its
range in the
continental USA
and Alaska.)



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

[Nationwide Conservation Measures](#) describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and

avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. [Additional measures](#) or [permits](#) may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS [Birds of Conservation Concern \(BCC\)](#) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the [Avian Knowledge Network \(AKN\)](#). The AKN data is based on a growing collection of [survey, banding, and citizen science datasets](#) and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle ([Eagle Act](#) requirements may apply), or a species that has a particular vulnerability to onshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the [AKN Phenology Tool](#).

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the [Avian Knowledge Network \(AKN\)](#). This data is derived from a growing collection of [survey, banding, and citizen science datasets](#).

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go to the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: [The Cornell Lab of Ornithology All About Birds Bird Guide](#), or (if you are unsuccessful in locating the bird of interest there), the [Cornell Lab of Ornithology Neotropical Birds guide](#). If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are [Birds of Conservation Concern](#) (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the [Eagle Act](#) requirements (for eagles) or (for non-eagles) potential susceptibilities in onshore areas from certain types of development or activities (e.g. onshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird

impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the [Northeast Ocean Data Portal](#). The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the [NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf](#) project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the [Diving Bird Study](#) and the [nanotag studies](#) or contact [Caleb Spiegel](#) or [Pam Loring](#).

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to [obtain a permit](#) to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the [National Wildlife Refuge](#) system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to [NWI wetlands](#) and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local [U.S. Army Corps of Engineers District](#).

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

The area of this project is too large for IPaC to load all NWI wetlands in the area. The list below may be incomplete. Please contact the local U.S. Fish and Wildlife Service office or visit the [NWI map](#) for a full list.

FRESHWATER EMERGENT WETLAND

[PEM1A](#)
[PEM1Fh](#)
[PEM1C](#)
[PEM1Ad](#)
[PEM1Ax](#)
[PEM1Cx](#)
[PEM1Ch](#)
[PEM1Ah](#)
[PEM1Cd](#)
[PEM1F](#)
[PEM1Ab](#)
[PEM1Fx](#)

FRESHWATER FORESTED/SHRUB WETLAND

[PFO1A](#)
[PFO1/4A](#)
[PFO1/4Ah](#)

FRESHWATER POND

[PAB4Hx](#)

LAKE

[L1UBHh](#)

[L2USC_x](#)[L2UBF_x](#)[L2USA_x](#)[L2USA_h](#)[L2UBF_h](#)[L2USC_h](#)

A full description for each wetland code can be found at the [National Wetlands Inventory website](#)

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tubercled worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specific agency regulatory programs and proprietary jurisdictions that may affect such activities.

Appendix B
Tribal and Historic Outreach Letters



U.S. Department
of Transportation
**Federal Aviation
Administration**

Aviation Safety

800 Independence Ave., S.W.
Washington, DC 20591

May 22, 2020

William Harris
Chief
Catawba Indian Nation
996 Avenue of the Nations
Rock Hill, SC 29730

Dear Chief Harris:

The purpose of this letter is to inform you of actions taken by the Federal Aviation Administration (FAA) under emergency procedures to allow operations of Unmanned Aircraft Systems (UAS) to deliver of medical or other essential supplies without exposing the recipient to human contact, in accordance with social distancing measures in support of the COVID-19 pandemic response. The FAA has issued a short-term Certificate of Waiver to Novant Health Covid-19 Response for operation of small UAS (under 55 pounds) along a route in North Carolina that will run through Davidson, Rowan, Cabarrus and Mecklenburg Counties. This is a waiver of certain provisions of 14 CFR part 107 to allow Novant's UAS to be flown in a manner not otherwise authorized by the regulation, namely operating over people and beyond visual line of sight, with adequate mitigations to establish the required level of safety within the national airspace system. UAS may be operated during daylight hours (7 am to 7 pm, Monday through Sunday, from May 14, 2020 to October 31, 2020, or until all COVID-related restrictions on travel, business, and mass gatherings have been lifted for the State of North Carolina, whichever date occurs first.

The circumstances precluded following standard FAA environmental review processes, including procedures under Section 106 of the National Historic Preservation Act and its implementing regulations at 36 CFR part 800. The FAA has determined that this proposed action is a Federal undertaking as defined in 36 CFR § 800.16 (y). Due to the novelty of UAS technology, we have not previously determined whether this type of operation is an activity with the potential to affect historic properties. Therefore, we are initiating consultation with you as well as with the North Carolina State Historic Preservation Officer (SHPO) pursuant to emergency procedures in 36 CFR § 800.12. Although circumstances did not permit a seven day consultation period to occur before the FAA issued this waiver, please note that the FAA can cancel the waiver or exemption and reissue it with modified or new terms to avoid, minimize or mitigate any adverse effects that may be identified subsequently through consultation.

Location and Description of Activity

The UAS routes will all originate from the same distribution center approximately 3.5 miles west of North Concord, NC. They will branch out to six different locations in Thomasville, Salisbury, Huntersville, Matthews, Harrisburg, and Huntersville Medical Center, as depicted on the enclosed graphics. The approximate lengths of each route from the distribution center are 46.17 miles to Thomasville, 20.50 miles to Salisbury, 12.85 miles to Huntersville, 26.21 miles to Matthews, 15.07 miles to Harrisburg and 15.40 miles to Huntersville Medical Center. All route operations will be conducted from 130 to 380 feet above ground. At full capacity, there could be 30 flight operations per day divided among the different routes. Use will be by lightweight unmanned aircraft.

We wish to solicit your views regarding potential effects on tribal interests in the area, particularly on any sites of religious or cultural significance that may be affected by the proposed routes. The FAA has limited experience with the effect of this type of UAS operation on tribal properties. The nature of small UAS operations generally limit effects to non-physical, reversible impacts (i.e., the introduction of audible and/or visual elements). That limited effect and the short-term duration of the waiver appear to support a determination of "no potential effect." However, the FAA is aware of the possibility that certain types of properties, such as some traditional cultural properties, could be particularly or uniquely sensitive to such effects, even if they are of short duration. Therefore, we are seeking your input under the emergency procedures in 36 CFR § 800.12 to identify and assess effects on any such resources in the areas overflown by these UAS.

Your response will greatly assist us in better understanding the potential effects of small UAS operations of this type on properties of religious or cultural significance to your tribe.

If you have any questions or need additional information regarding the proposed project, please do not hesitate to contact Mr. Mike Millard, in writing at: FAA, AFS-800, 800 Independence Ave., S.W., Washington, D.C. 20591; by telephone: (513) 842-9690; or by email: 9-AWA-AVS-AFS-ENVIRONMENTAL@faa.gov.

Sincerely,



Mark E. Giron
Aviation Safety
Manager, General Aviation Operations Branch,
Flight Standards Service

Enclosure

CC: (*via electronic mail*)

Wenonah George Haire, DMD, Tribal Historic Preservation Officer
Caitlin Rogers, Tribal Historic Preservation Officer Assistant

From: [Caitlin Rogers](#)
To: [Millard, Mike \(FAA\)](#)
Cc: [Thompson, Bradley CTR \(FAA\)](#)
Subject: FAA Section 106 Emergency Action
Date: Thursday, May 28, 2020 10:13:53 AM

We have no concerns for these temporary routes at the present time. If somehow, there would be ground disturbance, we would need to be consulted first. Thanks

Caitlin

Caitlin Rogers
Catawba Indian Nation
Tribal Historic Preservation Office
1536 Tom Steven Road
Rock Hill, SC 29730

803-328-2427 ext. 226

*** Please note that my email has changed to Caitlin.Rogers@catawba.com ***

Please Note: We CANNOT accept Section 106 forms via e-mail, unless requested. Please send us hard copies. Thank you for your understanding

Disclaimer

The information contained in this communication from the sender is confidential. It is intended solely for use by the recipient and others authorized to receive it. If you are not the recipient, you are hereby notified that any disclosure, copying, distribution or taking action in relation of the contents of this information is strictly prohibited and may be unlawful.

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U.S. Department
of Transportation
**Federal Aviation
Administration**

Aviation Safety

800 Independence Ave., S.W.
Washington, DC 20591

May 22, 2020

Ms. Renee Gledhill-Early
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 27699-4617

Via electronic submission to environmental.review@ncdcr.gov.

Dear Ms. Gledhill-Early:

The purpose of this letter is to inform you of actions taken by the Federal Aviation Administration (FAA) under emergency procedures to allow operations of Unmanned Aircraft Systems (UAS) to deliver medical or other essential supplies without exposing the recipient to human contact, in accordance with social distancing measures in support of the COVID-19 pandemic response. The FAA has issued a short-term Certificate of Waiver to Novant Health Covid-19 Response for operation of small UAS (under 55 pounds) along a route that will run through Davidson, Rowan, Cabarrus and Mecklenburg Counties. This is a waiver of certain provisions of 14 CFR part 107 to allow Novant's UAS to be flown in a manner not otherwise authorized by the regulation, namely operating over people and beyond visual line of sight, with adequate mitigations to establish the required level of safety within the national airspace system. UAS may be operated during daylight hours (7 am to 7 pm, Monday through Sunday, from May 14, 2020 to October 31, 2020, or until all COVID-related restrictions on travel, business, and mass gatherings have been lifted for the State of North Carolina, whichever date occurs first.

The circumstances precluded following standard FAA environmental review processes, including procedures under Section 106 of the National Historic Preservation Act and its implementing regulations at 36 CFR part 800. The FAA has determined that this proposed action is a Federal undertaking as defined in 36 CFR § 800.16 (y). Due to the novelty of UAS technology, we have not previously determined whether this type of operation is an activity with the potential to affect historic properties. Therefore, the FAA is initiating consultation with you as the State Historic Preservation Officer (SHPO) pursuant to emergency procedures in 36 CFR § 800.12. Although circumstances did not permit a seven day consultation period to occur before the FAA issued this waiver, please note that the FAA can cancel the waiver or exemption and reissue it with modified or new terms to avoid, minimize or mitigate any adverse effects that may be identified subsequently through consultation.

Location and Description of Activity

The UAS routes will all originate from the same distribution center approximately 3.5 miles west of North Concord, NC. They will branch out to six different locations in Thomasville, Salisbury, Huntersville, Matthews, Harrisburg, and Huntersville Medical Center, as depicted on the enclosed graphics. The approximate lengths of each route from the distribution center are 46.17 miles to Thomasville, 20.50 miles to Salisbury, 12.85 miles to Huntersville, 26.21 miles to Matthews, 15.07 miles to Harrisburg and 15.40 miles to Huntersville Medical Center. All route operations will be conducted from 130 to 380 feet above ground. At full capacity, there could be 30 flight operations per day divided among the different routes.

Potential Effects on Historic Properties

The FAA has limited experience with the effect of this type of UAS operation on historic properties. The nature of small UAS operations generally limit effects to non-physical, reversible impacts (i.e., the introduction of audible and/or visual elements). That limited effect and the short-term duration of the waiver appear to support a determination of “no potential effect.” However, the FAA is aware of the possibility that certain types of properties, such as some traditional cultural properties, could be particularly or uniquely sensitive to such effects, even if they are of short duration. Therefore, we are seeking your views under the emergency procedures in 36 CFR § 800.12, and are also initiating consultation with the Catawba Indian Nation to identify and assess effects on any such resources in the areas overflown by these UAS.

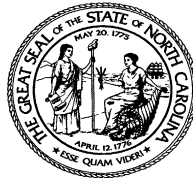
Your response is appreciated. If you have any questions or need additional information regarding the proposed project, please do not hesitate to contact Mr. Mike Millard, in writing at: FAA, AFS-800, 800 Independence Ave., S.W., Washington, D.C. 20591; by telephone: (513) 842-9690; or by email: 9-AWA-AVS-AFS-ENVIRONMENTAL@faa.gov.

Sincerely,



Mark E. Giron
Aviation Safety
Manager, General Aviation Operations Branch,
Flight Standards Service

Enclosure



**North Carolina Department of Natural and Cultural Resources
State Historic Preservation Office**

Ramona M. Bartos, Administrator

Governor Roy Cooper
Secretary Susi H. Hamilton

Office of Archives and History
Deputy Secretary Kevin Cherry

May 29, 2020

Mike Millard
FAA, AFS-800
800 Independence Ave., S.W.
Washington, D.C. 20591

9-AWA-AVS-AFS-ENVIRONMENTAL@faa.gov

RE: Emergency waiver to allow operations of Unmanned Aircraft Systems (UAS) to deliver medical or other essential supplies, Multi County, ER 20-1104

Dear Mr. Millard:

We are in receipt of Mark E. Giron's May 22, 2020, letter providing information concerning the above-referenced emergency waiver. Having reviewed the materials provided, we believe that there is little potential for the flights, as described, to affect properties listed in or eligible for listing in the National Register of Historic Places. However, should such properties be affected we do not believe that there would be an adverse effect. Further, we understand that this is a time-limited waiver and once expired, the Federal Aviation Administration (FAA) will undertake the regular project review process.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-814-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

 Ramona Bartos, Deputy
State Historic Preservation Officer



U.S. Department
of Transportation
**Federal Aviation
Administration**

Aviation Safety

800 Independence Ave., S.W.
Washington, DC 20591

August 3, 2020

Ms. Renee Gledhill-Early
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 27699-4617

Via electronic submission to environmental.review@ncdcr.gov.

Dear Ms. Gledhill-Early:

The purpose of this letter is to initiate formal government-to-government consultation regarding issuance by the Federal Aviation Administration (FAA) for the approval of a Certificate of Waiver and/or Exemption for an Unmanned Aircraft System (UAS) route to deliver medical or other essential supplies. This request is for operation of small lightweight UAS (under 55 pounds) along a route in North Carolina that will run through Davidson, Rowan, Cabarrus and Mecklenburg Counties. This is a Certificate of Waiver and/or Exemption of certain provisions of 14 CFR part 107 to allow UAS to be flown in a manner not otherwise authorized by the regulation, namely operating over people and beyond visual line of sight, with adequate mitigations to establish the required level of safety within the national airspace system. UAS operations will be during daylight hours, 7 am to 7 pm, Monday through Sunday. We wish to solicit your views regarding potential effects on tribal interests in the area. The FAA has determined that this proposed action is a Federal undertaking as defined in 36 CFR § 800.16 (y). Therefore, the FAA is initializing consultation with the State Historic Preservation Officer (SHPO) pursuant to § 800.11 (d).

This route is currently being flown under emergency circumstances in support of the global COVID-19 pandemic requiring immediate actions that precluded following standard NEPA processes by the Federal Aviation Administration (FAA). We sent a previous letter on May 22, 2020 for the emergency action, and you responded with no concerns for these temporary routes on May 29, 2020 (ER 20-1104). This route is going to become a long-term operation beyond the short term emergency action, requiring us to consult with you for the change. There is no expected ground disturbance associated with this UAS operation flight route.

Location and Description of Activity

The Federal Aviation Administration (FAA) has been asked to approve waivers and/or exemptions to aeronautical regulations, thereby approving the UAS routes. FAA approval of the UAS routes is an undertaking subject to regulations pursuant to the National Historic Preservation Act.

The UAS routes will all originate from the same distribution center approximately 3.5 miles west of North Concord, NC. They will branch out to six different locations in Thomasville, Salisbury, Huntersville, Matthews, Harrisburg, and Huntersville Medical Center, as depicted on the enclosed graphics. The approximate lengths of each route from the distribution center are 46.17 miles to Thomasville, 20.50 miles to Salisbury, 12.85 miles to Huntersville, 26.21 miles to Matthews, 15.07 miles to Harrisburg and 15.40 miles to Huntersville Medical Center. All route operations will be conducted from 130 to 380 feet above ground. At full capacity, there could be 30 flight operations per day divided among the different routes. The dimensions of the UAS routes define the Area of Potential Effect (APE). According to the National Park Service online database of the National Register of Historic Places, there are no registered historical places within the proposed APE. The UAS routes will have no affects to the ground.

Consultation

The FAA seeks concurrence from the SHPO of its no historic properties affected [§ 800.11 (d)] determination for the proposed UAS route. Your response over the next 30 days will greatly assist us in incorporating your concerns into our environmental review of the operation.

Your response is appreciated. If you have any questions or need additional information regarding the proposed operation, please do not hesitate to contact Mr. Mike Millard, in writing at: FAA, AFS-800, 800 Independence Ave., S.W., Washington, D.C. 20591; by telephone: (202) 267-7906; or by email: 9-AWA-AVS-AFS-ENVIRONMENTAL@faa.gov.

Sincerely,



Mark E. Giron
Aviation Safety
Manager, General Aviation Operations Branch,
Flight Standards Service

Enclosure



U.S. Department
of Transportation
**Federal Aviation
Administration**

Aviation Safety

800 Independence Ave., S.W.
Washington, DC 20591

August 3, 2020

William Harris
Chief
Catawba Indian Nation
996 Avenue of the Nations
Rock Hill, SC 29730

Dear Chief Harris:

The purpose of this letter is to initiate formal government-to-government consultation regarding issuance by the Federal Aviation Administration (FAA) for the approval of a Certificate of Waiver and/or Exemption for an Unmanned Aircraft System (UAS) route to deliver medical or other essential supplies. This request is for operation of small lightweight UAS (under 55 pounds) along a route in North Carolina that will run through Davidson, Rowan, Cabarrus and Mecklenburg Counties. This is a Certificate of Waiver and/or Exemption of certain provisions of 14 CFR part 107 to allow UAS to be flown in a manner not otherwise authorized by the regulation, namely operating over people and beyond visual line of sight, with adequate mitigations to establish the required level of safety within the national airspace system. UAS operations will be during daylight hours, 7 am to 7 pm, Monday through Sunday. We wish to solicit your views regarding potential effects on tribal interests in the area.

This route is currently being flown under emergency circumstances in support of the global COVID-19 pandemic requiring immediate actions that precluded following standard NEPA processes by the Federal Aviation Administration (FAA). We sent a previous letter on May 22, 2020 for the emergency action, and you responded with no concerns for these temporary routes on May 28, 2020. This route is going to become a long-term operation beyond the short term emergency action, requiring us to consult with you for the change. There is no expected ground disturbance associated with this UAS operation flight route.

Location and Description of Activity

The UAS routes will all originate from the same distribution center approximately 3.5 miles west of North Concord, NC. They will branch out to six different locations in Thomasville, Salisbury, Huntersville, Matthews, Harrisburg, and Huntersville Medical Center, as depicted on the enclosed graphics. The approximate lengths of each route from the distribution center are 46.17 miles to Thomasville, 20.50 miles to Salisbury, 12.85 miles to Huntersville, 26.21 miles to Matthews, 15.07 miles to Harrisburg and 15.40 miles to Huntersville Medical Center.



**North Carolina Department of Natural and Cultural Resources
State Historic Preservation Office**

Ramona M. Bartos, Administrator

*Governor Roy Cooper
Secretary Susi H. Hamilton*

*Office of Archives and History
Deputy Secretary Kevin Cherry*

August 20, 2020

Mark E. Giron
FAA
800 Independence Avenue South West
Washington, DC 20591

9-awa-avs-afs-environmental@faa.gov

Re: Emergency procedure: Operations of Unmanned Aircraft Systems to deliver medical supplies, six locations in Thomasville, Salisbury, Huntersville, Matthews, & Harrisburg, Multiple County, ER 20-1104

Dear Mark E. Giron

Thank you for your letter of August 3, 2020, concerning the above project.


We have conducted a review of the project and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the project as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-814-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

A handwritten signature in blue ink that reads "Renee Gledhill-Earley".

 Ramona Bartos, Deputy
State Historic Preservation Officer

All route operations will be conducted from 130 to 380 feet above ground. At full capacity, there could be 30 flight operations per day divided among the different routes.

Consultation

The FAA is soliciting the opinion of the tribe(s) concerning any tribal lands, or sites of religious or cultural significance that may be affected by the proposed routes. Your response over the next 30 days will greatly assist us in better understanding the potential effects of small UAS operations of this type on properties of religious or cultural significance to your tribe.

If you have any questions or need additional information regarding the proposed project, please do not hesitate to contact Mr. Mike Millard, in writing at: FAA, AFS-800, 800 Independence Ave., S.W., Washington, D.C. 20591; by telephone: (202) 267-7906; or by email: 9-AWA-AVS-AFS-ENVIRONMENTAL@faa.gov.

Sincerely,



Mark E. Giron
Aviation Safety
Manager, General Aviation Operations Branch,
Flight Standards Service

Enclosure

CC: (*via electronic mail*)

Wenonah George Haire, DMD, Tribal Historic Preservation Officer
Caitlin Rogers, Tribal Historic Preservation Officer Assistant

Appendix C
Noise Analysis Report

Noise Assessment for Zipline Proposed Package Delivery Operations with Sparrow Unmanned Aircraft

In support of U.S. Code of Federal Regulations Title 14, Part 135

Final

HMMH Report No. 309990.003-4

January 5, 2022

Prepared for:

JD RoVolus, LLC
121 Pearl Street
Ypsilanti, MI 48197

Federal Aviation Administration
Aviation Safety, Flight Standards Service
Office of Environment and Energy
Policy, Engineering, Analysis, and Research (PEARS II)
693KA9-18-D-00005



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Noise Assessment for Zipline Proposed Package Delivery Operations with Sparrow Unmanned Aircraft

In support of U.S. Code of Federal Regulations Title 14, Part 135

Final

HMMH Report No. 309990.003-4

January 5, 2022

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121 Pearl Street
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Federal Aviation Administration
Aviation Safety, Flight Standards Service
Office of Environment and Energy
Policy, Engineering, Analysis, and Research (PEARS II)
693KA9-18-D-00005

Prepared by:
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Contents

1	Introduction and Background	1
2	Unmanned Aircraft Delivery Operations and Noise Measurement Data Set Descriptions.....	3
2.1	Operations, Flight Paths, and Flight Profile Data	3
2.1.1	Operations.....	3
2.1.2	Flight Paths and Profiles.....	3
2.2	Acoustical Data.....	9
3	Methodology for Data Analysis	11
3.1	Application of Operations	11
3.2	Nest Infrastructure.....	12
3.3	Launch and Climb.....	12
3.4	Application of Acoustical Data	13
3.4.1	General Assumptions	13
3.4.2	Launch.....	13
3.4.3	Aircraft Flight.....	14
3.4.4	Recovery.....	15
3.5	Proposed DNL Estimation Methodology.....	15
3.5.1	DNL for Launch Operations	15
3.5.2	DNL for En Route.....	16
3.5.3	DNL for Delivery Sites.....	16
3.5.4	DNL for Recovery Operations.....	16
3.5.5	DNL for Nest Activities	17
4	Noise Exposure Estimate Results.....	19
4.1	Noise Exposure for Operations at the Nest.....	19
4.1.1	Nest Flight Paths Are Known to Be on a Single Axis.....	21
4.1.2	Nest Flight Paths are Not Known or Varied.....	22
4.2	Noise Exposure under En Route Paths.....	23
4.3	Noise Exposure for Operations under Delivery.....	25

Figures

Figure 1. Sparrow Unmanned Aircraft.....	1
Figure 2. Flight Profile Example	4
Figure 3. Annotated Example Delivery Flight Path.....	5
Figure 4. UA on the Launcher.....	6
Figure 5. Top Down Diagram of Nominal Delivery Pattern Dimensions.....	7
Figure 6. Profile View of Delivery Patterns	8
Figure 7. The Recovery System Raising to Recover a Returning UA	9
Figure 8. Conceptual Nest Extents.....	12
Figure 9. Demonstration of Determining Extent of DNL 45 dB at Nest with Flight Paths at 180 Degrees	22
Figure 10. Demonstration of Determining Extent of DNL 45 dB at a Nest for Flight Paths are Not Known or Varied	23
Figure 11. Annotated Example Delivery Flight Path around Delivery Site.....	26

Tables

Table 1. SEL and L_{Amax} Relationship Relative to Distance.....	10
Table 2. Estimated Extent of Noise Exposure from the Nest per Number of Deliveries - Under Flight Paths	20
Table 3. Estimated Extent of Noise Exposure from the Nest per Number of Deliveries - Sideline	21
Table 4. Estimated DNL Directly Under En Route Flight Paths at Various Altitudes and Ground Speeds.....	24
Table 5. Estimated DNL Directly Under Overflights.....	25
Table 6. Estimated Maximum DNL at Delivery Site	27

1 Introduction and Background

This document presents the methodology and estimation of noise exposure related to proposed Unmanned Aircraft (UA) package delivery operations conducted by Zipline as a commercial operator under the provisions of 14 CFR Part 135. Zipline is proposing to perform package delivery operations at multiple potential locations in the continental United States utilizing an operational model that involves a central distribution center (a “nest”) and supporting route network to transport packages to delivery locations (“delivery sites”) in the surrounding communities such as medical centers, health facilities, and private homes.

Nest and delivery sites are driven by partnerships Zipline has established with health organizations, retailers, and other businesses to deliver medical supplies and retail goods to surrounding communities. Flight paths to and from the nest and delivery sites use a network or route plans, with a structure of common flight path segments near the nest and various branches to deliver to individual locations.¹ Delivery sites are selected by Zipline after potential customers are identified and their specific locations have been surveyed and satisfy various criteria.

The Zipline Sparrow Unmanned Aircraft is unique to Zipline, and often referred to as a “Zip.”² The UA is a fixed-wing design powered by two electric motors, mounted on a single pylon above the fuselage, turning three-bladed propellers. The wingspan is 10 feet, 10 inches, with a fuselage length of 6 feet, 2 inches. The maximum takeoff weight is listed as 49.3 pounds. Figure 1 depicts the UA considered in this report.

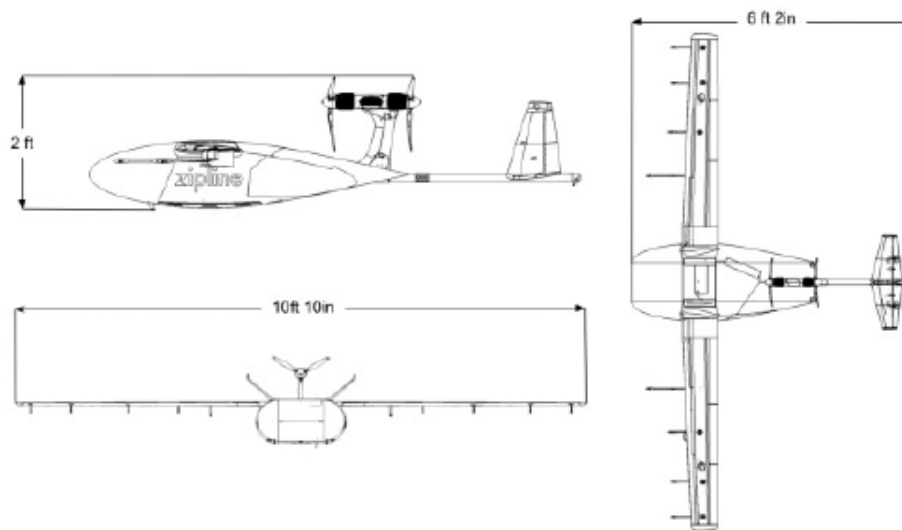


Figure 1. Sparrow Unmanned Aircraft

¹ Zipline materials defined “route plan” as “Standardized and static end to end path of a [UA] to and from a delivery location (originating from a nest) that includes considerations for altitude, keep-out areas, etc.”

² According to the definitions in Zipline’s CONOPS dated June 7, 2021, regulatory technical documents regarding the UA are titled “Sparrow Unmanned Aircraft Flight Manual” and “Sparrow Unmanned Aircraft Maintenance Manual.” Therefore Sparrow is used in this document for consistency.

As a fixed-wing design, the UA needs forward airspeed to remain in controlled flight, and general operating airspeeds are expected to be in the range of 45 to 60 knots. The UA is launched via catapult at the nest and then climbs to en route altitude, at which point it navigates along a defined path from the nest to the intended delivery site. The en route portion of the flight would generally be operated at an altitude of 250 feet Above Ground Level (AGL) and is always below an altitude of 400 feet AGL. Approaching the delivery site, the UA flies a pattern near the delivery point, descends to 60 feet AGL, drops the package via parachute at a pre-defined drop zone, climbs to en route altitude, and then flies along a defined path for recovery at the nest via a recovery system.

The methodology proposed in this document provides quantitative guidance to FAA Environmental Specialists to inform environmental decision making on UA noise exposure from proposed Zipline package delivery operations. The methods presented here are suitable for review of Federal actions under the requirements of the National Environmental Policy Act (NEPA) and other applicable environmental special purpose laws or other federal environmental review requirements at the discretion and approval of the FAA. In particular, the anticipated use of this report is to function as a non-standard equivalent methodology under FAA Order 1050.1F, and as such, would require prior written approval from FAA's Office of Environment and Energy (AEE) for each individual project for which a NEPA determination is sought.³

The methodology has been developed with data provided by Zipline and FAA to date and therefore is limited to Zipline operations with the Sparrow UA and the flight phases and maneuvers described herein. The noise analysis methodology and estimated noise levels of the proposed activity levels are based upon noise measurement data provided by Zipline and reviewed by FAA. Results of the noise analysis are presented in terms of the Day-Night Average Sound Level (DNL) based on varying levels of operations for areas at ground level below each phase of the flight.⁴

Section 2 of this document describes the relevant noise and operations data made available by Zipline and FAA. Section 3 describes the approach to developing noise exposure estimates for the various UA flight phases associated with typical operations from the available data. Section 4 presents the estimated DNL levels for various flight phases based on varying levels of typical operations as described by Zipline to date.

³ Discussion of the use of "another equivalent methodology" is discussed in FAA Order 1050.1F, July 16, 2015, Appendix B, Section B-1.2, available online at https://www.faa.gov/documentlibrary/media/order/faa_order_1050_1f.pdf#page=113

⁴ Discussion of modification of this process for use of the Community Noise Equivalent Level metric (CNEL) is discussed in Section 3.1.

2 Unmanned Aircraft Delivery Operations and Noise Measurement Data Set Descriptions

Six data sets formed the basis of the noise assessment for the proposed Zipline delivery operations. The data sets include the CONOPS dated June 7, 2021, Noise Test Data report dated September 24, 2021, sample flight track data received on October 29, 2021, and correspondence to FAA's Office of Environment and Energy (AEE) dated April 27, 2021, September 30, 2021, and October 20, 2021.⁵ These data sets form the basis for conducting the noise analysis for proposed UA delivery operations. The following subsections provide additional detail on each data source.

2.1 Operations, Flight Paths, and Flight Profile Data

Operations and flight profile data for the UA provided by Zipline were reviewed to determine the characteristics of typical operations for a proposed operating area. Based on this review, the following subsections detail the operations and flight profile assumptions that were used to inform the development of the inputs for calculating estimated noise exposure and the methodology for the noise analysis.

2.1.1 Operations

The methodology presented in this report can be used to assess UA noise over a range of proposed activity levels; however, FAA review and approval of its use at specified activity levels is required. The activity ranges shown below in Section 4 represent what FAA considers low to moderate activity levels and anticipates as being appropriate for consideration with this methodology. At higher activity levels, this methodology may not be sufficient to inform an environmental determination and further consideration or refinements at the discretion of the FAA may be needed.

Note that DNL noise levels presented in this report are all shown consistent with effective daytime (7 AM to 10 PM) operations levels. For consideration of nighttime (10 PM to 7 AM) noise levels, a ten times operational weighting (equivalent to DNL 10 dB increase) should be applied. Section 3.5 and Section 4 provide techniques to apply the operational weighting and to calculate effective operations for analysis with the DNL metric.

2.1.2 Flight Paths and Profiles

The UA will fly a network of defined flight paths between a central distribution center (known as a "nest") and delivery sites that are developed on an "as-needed basis." Each delivery site is based on customer demand and a suitability survey specific to each candidate location. The nest includes a launcher and recovery apparatus for the UA, along with a building to recharge, pack, and prepare the UAs for deliveries. After launch from the nest, the UA will use the defined flight paths to navigate on

⁵ Most of these documents have various markings indicating that the contents are "Confidential & Proprietary". Only elements required to support the noise analysis methodology have been disclosed in this report.

both the outbound (nest to delivery) and inbound (post-delivery to recovery) legs. The UA uses the United States Global Positioning System (GPS) for navigation.

Analysis of flight profile data provided by Zipline revealed that a typical profile for operations of the UA can be broken into four discrete phases as described below, in the following sub-sections, and depicted in Figure 2 and Figure 3:

- Launch and climb: Includes launch from the nest and climb to en route altitude.
- En route: Includes flight of the UA to and from the nest at en route altitude. The UA will use the same flight path to and from the nest to a delivery site and may include circular or oval patterns along the route, as needed, for weather and operational conditions.
- Delivery: This includes a unique delivery flight pattern, with orientation dependent upon wind direction and the delivery site.
- Descent and recovery: This includes inbound descent from en route flight and recovery at the nest.

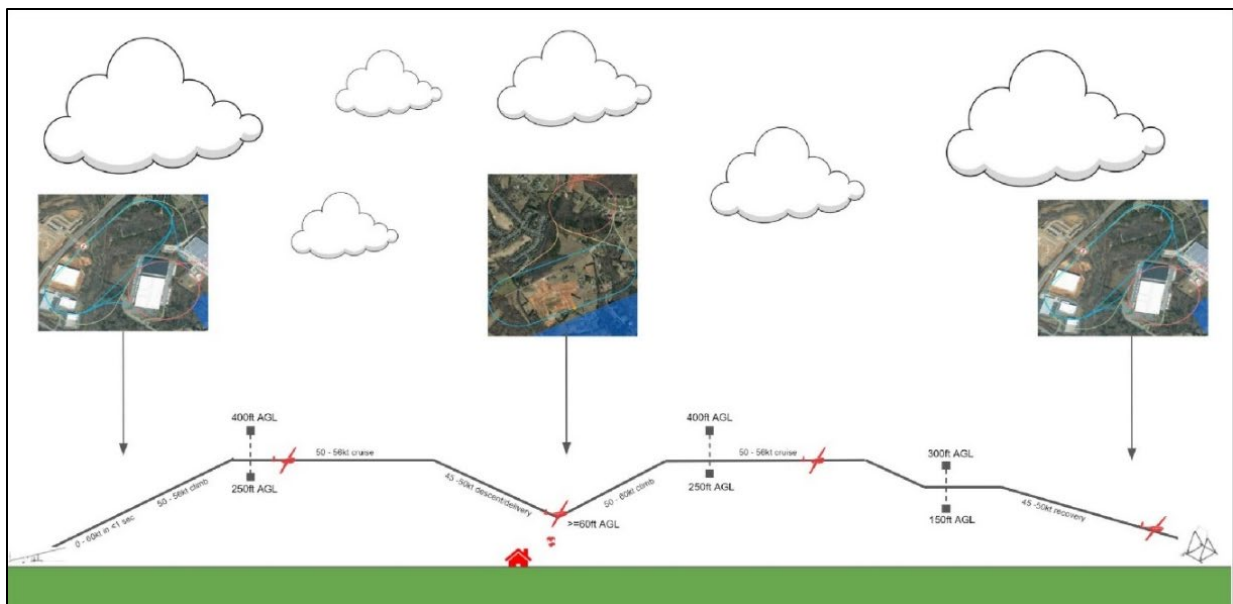


Figure 2. Flight Profile Example

Source: Zipline, September 30, 2021

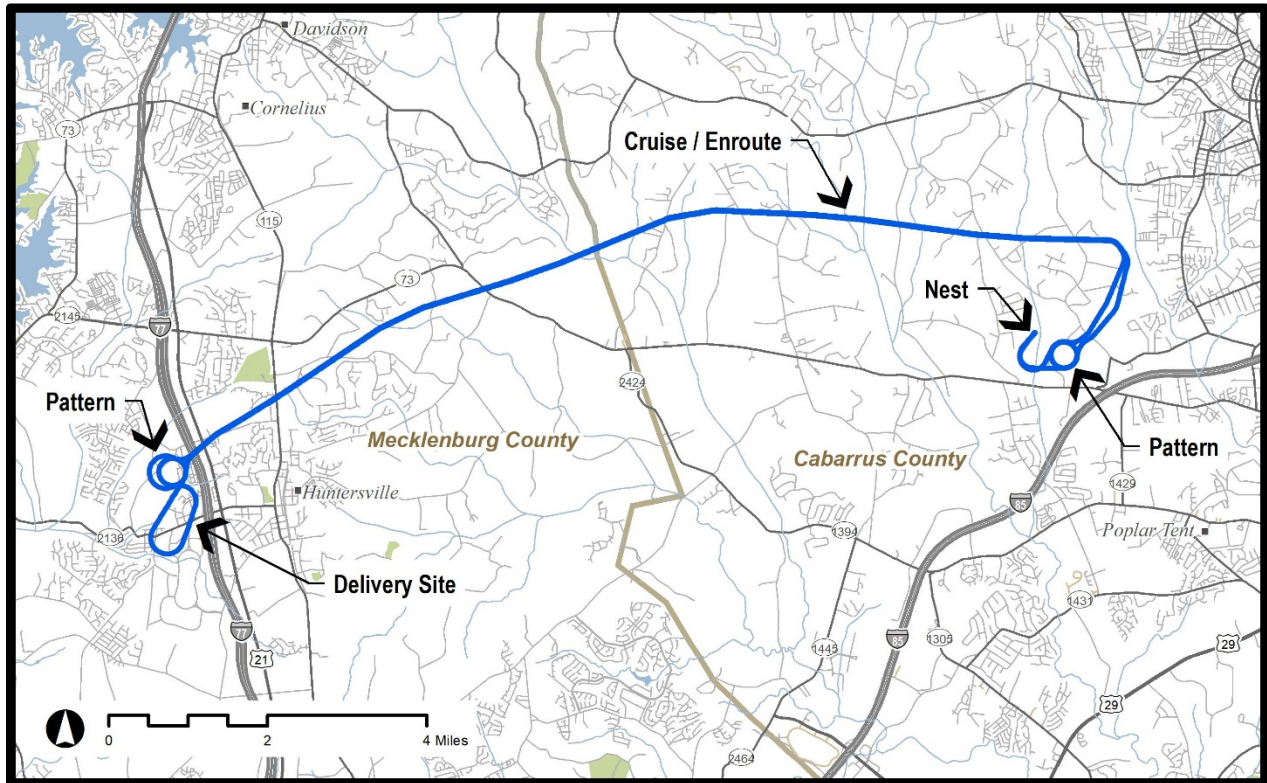


Figure 3. Annotated Example Delivery Flight Path

Sources: Zipline, October 29, 2021; Annotations by HMMH

2.1.2.1 Launch and Climb

During the launch and climb phase, the UA is launched from the nest using a catapult mechanism (a “launcher”) as depicted in Figure 4. The launcher is expected to launch the aircraft to 60 knots ground speed, at which point the UA will separate from the launcher and then maintain a nominal climb trajectory at an airspeed of 50 to 56 knots and a climb angle of approximately 8 to 11 degrees until reaching en route altitude.



Figure 4. UA on the Launcher

Source: Zipline, CONOPS, June 7, 2021

2.1.2.2 En route

En route is defined as the phase of flight where the UA transits to and from the nest to delivery sites on a defined network of flight paths. During this flight phase, the UA will typically operate at an altitude of 250 ft Above Ground Level (AGL) and a nominal airspeed of 56 knots. However, the UA may operate at altitudes as low as 130 ft AGL or as high as 400 ft AGL, and with possible ground speeds as low as 40 knots.

Once defined, a particular en route path is expected to be flown consistently, as the UA uses GPS for navigation. As shown in Figure 3, the en route paths are the same for the inbound and outbound legs. A single en route path may support a handful of delivery sites at the edges of the operational area or may, very close to the nest, support the majority of the delivery sites.

In some instances, the UA may enter a circular holding pattern en route to or from a delivery. Holding may occur at a series of defined static holding points or at ad-hoc holding dictated as necessary along the route. Duration spent in holding, the size of the holding pattern, and orientation of the holding pattern is dictated based on operational necessity, weather, and terrain. However, the radius of the

holding pattern flown by the UA is not expected to exceed approximately 820 feet for static holds and approximately 1,640 feet for ad-hoc holds, respectively. When holding is conducted within the en route path, the UA is anticipated to maintain altitudes and speeds consistent with typical en route operations.

2.1.2.3 Delivery

The delivery phase of flight is defined by descent from the en route phase to a delivery site to deliver a package. The delivery occurs within a 40 foot by 40-foot square drop zone in a designated area pre-surveyed by Zipline for suitability before use. The flight path flown by the UA during the delivery phase is chosen at the time of the flight such that the UA is flying into the wind to minimize ground speed at the time of the package release.

During the delivery phase, both prior to and after delivery, there are several associated “pattern” turns flown by the UA that could occur within approximately 1 to 1.5 statute miles of the drop zone. Figure 5 and Figure 6 show the top-down view of a typical delivery pattern and the altitude profile information, respectively.

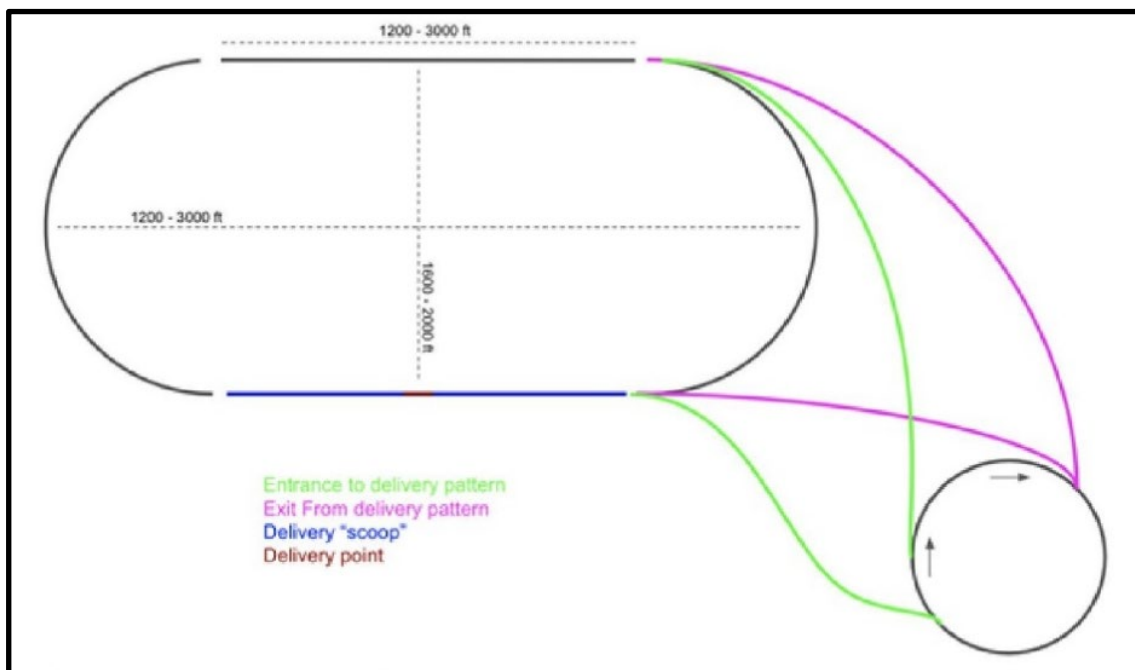


Figure 5. Top Down Diagram of Nominal Delivery Pattern Dimensions

Source: Zipline, April 27, 2021

Figure 6 depicts typical altitude profiles of the UA while in the delivery pattern. The package release during delivery is preceded by a straight segment descending from approximately 130 ft AGL or higher at a descent angle of approximately eight degrees to the package release altitude. The actual package release occurs at or above 60 ft AGL at a ground speed of 40 knots. After package release, the UA climbs to an altitude of at least 130 ft AGL at a climb angle of approximately eight degrees. The UA will then

commence one or more turns to rejoin the en route flight path, as described in Section 2.1.2.2, for return to the nest and recovery.

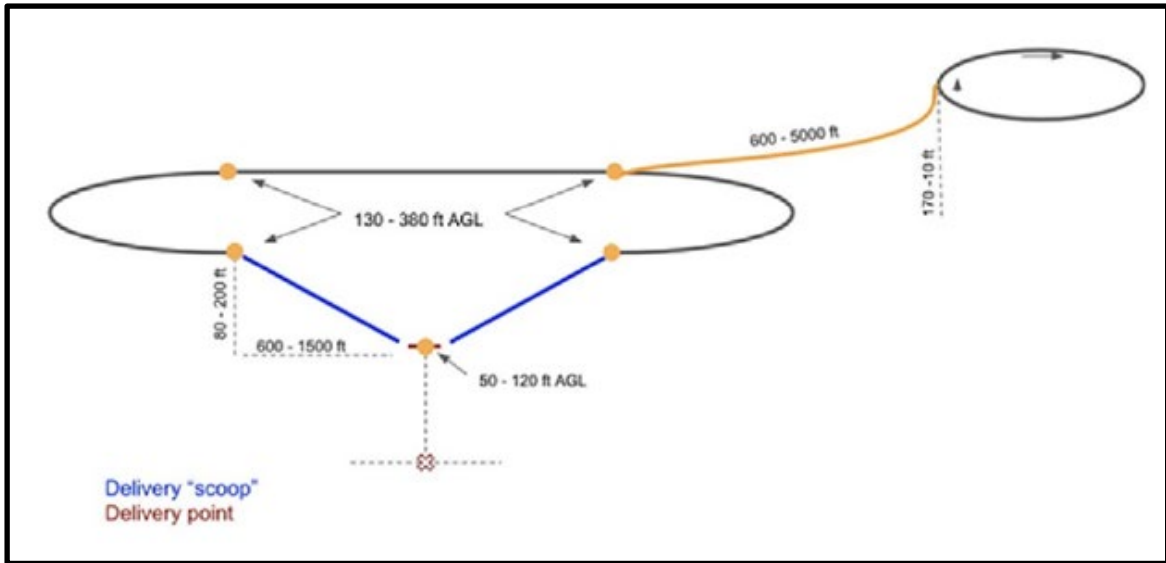


Figure 6. Profile View of Delivery Patterns

Source: Zipline, April 27, 2021

2.1.2.4 Descent and Recovery

The recovery phase of flight is defined as descent from the en route flight phase and recovery of the UA at the nest. The UA is recovered at the nest using a cable recovery mechanism as depicted in Figure 7. Approaching the nest, the UA will descend from en route altitude to 36 feet AGL, at a descent angle of approximately six degrees and an airspeed of 50 to 56 knots. The UA will then be arrested and quickly decelerate via a hook engaging a cable as part of the recovery infrastructure and then lowered to the ground for reuse.



Figure 7. The Recovery System Raising to Recover a Returning UA

Source: Zipline, CONOPS, 6/7/2021

2.2 Acoustical Data

Noise measurement data were provided by Zipline, representative of each phase of the flight (launch, en route, delivery, and recovery). The noise measurements were performed at a Zipline facility near Esparto, California, between August 10, 2021, and September 14, 2021 and provided in a September 24, 2021 document.

In some cases, the data set provided multiple samples of the same operating conditions; the more conservative sample is used for this analysis. The provided documentation does not fully describe the test setup for all measurements. In instances where the distances between the microphone and the noise source are not stated, they are estimated based on the geometry described in the measurement narrative.

Table 1 presents the various measurements of SEL and L_{Amax} that are used in this analysis.

Table 1. SEL and L_{Amax} Relationship Relative to Distance

Source: Zipline, September 24, 2021

Measurement	Distance between Source and Microphone (ft)	SEL (dB)	L _{Amax} (dB)	Note
Launch Under Track	15.0*	81.9	86.4	Nest launch/departure measurement with the microphone positioned under flightpath. Assume this includes launch and launcher noise; distance estimated because altitude over microphone was not provided.
Launch Sideline	50.0	75.5	78.3	Nest launch/departure measurement with microphone positioned sideline/lateral/perpendicular to launcher orientation and flightpath; assume this includes launch and launcher noise.
Recovery	59.4*	72.8	76.4	Nest Recovery Noise. Distance estimated based on 50 ft from recovery location and oriented sideline/perpendicular of aircraft approach path; assume a recover altitude of 32 ft relative to the microphone.
Delivery	56.0*	68.1	66.5	Delivery Noise Distance estimated based on indicated flight altitude of 60 ft AGL and estimated microphone height of 4 feet AGL; assume delivery speed is 45 knots based on the middle of the ranges presented.
Notes: *Distance between sound source microphone not provided explicitly. These values are estimated distances as discussed in the Note field.				

3 Methodology for Data Analysis

The previously described data sets were used to develop a method to estimate community noise exposure that could result from Zipline delivery operations originating at a single nest within a proposed single area of operations, with each nest operating up to seven days a week with varying levels of daily and equivalent annual delivery operations. There are currently no standardized tools or processes in place to conduct a noise assessment for the proposed operational scenario and UA. HMMH, with detailed technical guidance from the FAA Office of Environment and Energy, developed a customized noise exposure prediction process based on the available data to conduct this analysis. The following subsections describe that noise analysis methodology.

3.1 Application of Operations

The DNL metric applies a 10 dB weighting for operations between 10 PM and 7 AM. The 10 dB weighing is mathematically equivalent to 10 times the number of operations. Therefore, the operations near point i can be weighted to develop a daytime equivalent number of operations ($N_{equiv,i}$). The generalized form is expressed in Equation (1).⁶

$$N_{Equiv,i} = W_{Day} \times N_{Day,i} + W_{Eve} \times N_{Eve,i} + W_{Night} \times N_{Night,i} \quad (1)$$

Where:

- $N_{Day,i}$ is the number of user-specified operations between 7 AM and 7 PM local time
- $N_{Eve,i}$ is the number of user-specified operations between 7 PM and 10 PM local time
- $N_{Night,i}$ is the number of user-specified operations between 10 PM and 7 AM local time
- W_{Day} is the day-time weighting factor, which is 1 operation for DNL
- W_{Eve} is the evening weighting factor, which is 1 operation for DNL
- W_{Night} is the night-time weighting factor, which is 10 operations for DNL

For the DNL metric, the number of DNL daytime equivalent operations, $N_{DNL,i}$ simplifies to

$$N_{DNL,i} = N_{Day,i} + N_{Eve,i} + 10 \times N_{Night,i} \quad (2)$$

In practice, Equation (2) can be further simplified by defining the user-defined operations between 7 AM and 10 PM as a single value, rather than tracking $N_{Day,i}$ and $N_{Eve,i}$ separately.

⁶ Equation (1) has includes the three time periods of day, evening, night for consistency with other FAA documents that discuss the development of time averaging metrics such as DNL from individual SELs. Presentation of Equation (1) also allows the practitioner to modify this process for the CNEL metric for use in California.

For the Community Noise Equivalent Level (CNEL) metric, which may be used in California, the number of CNEL daytime equivalent operations, $N_{CNEL,i}$ simplifies to

$$N_{CNEL,i} = N_{Day,i} + 3 \times N_{Evening,i} + 10 \times N_{Night,i} \quad (3)$$

3.2 Nest Infrastructure

As noted in Section 1 and Section 2.1.2, Zipline's central operation facility is called a nest. The nest includes the launcher (Section 2.1.2.1), the recovery mechanism (Section 2.1.2.4), along with a building/facility to recharge, pack, and prepare the UAs. For the purpose of this noise analysis methodology, the Nest Extents depicted in Figure 8 refer to the portion of the property in which the launcher and recovery gear could be positioned. The Nest Extents, for the noise analysis shall be a rectangle, circle, or other polygon that includes all the possible locations for the launcher and the recovery gear.⁷

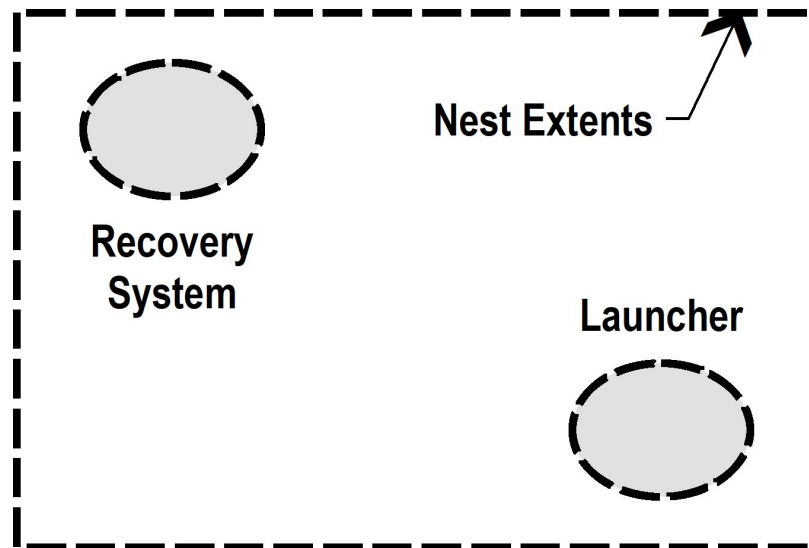


Figure 8. Conceptual Nest Extents

Source: HMMH

3.3 Launch and Climb

As noted in Section 2.1.2.1, the launcher is expected to launch the aircraft to 60 knots ground speed. Nominal climb trajectory after launch is stated to have an angle of approximately 8 to 11 degrees at an airspeed of 50 to 56 knots. For noise estimation, the eight-degree value is used as it places aircraft close to the ground, yielding a conservative/louder noise estimate. Since the en route portion is described as being level flight at 250 ft AGL, the climb phase associated with a launch extends about 1,800 feet ground track distance from the launcher.⁸ The aircraft ground speed will be assumed to be initially 40

⁷ Materials indicate that the launcher and recovery gear are made to be moved as needed.

⁸ To reach an altitude of 250 ft with a 8 degree climb $250 \text{ ft} / \tan(8 \text{ deg}) = 1,778 \text{ ft}$.

knots based on the 56-knot nominal airspeed and an assumed 16-knot headwind. This lower ground speed will increase event duration and provide a slightly more conservative noise level estimate compared to a faster ground speed.

3.4 Application of Acoustical Data

The Day-Night Average Sound Levels (DNLs) can be estimated with a summation of the Sound Exposure Levels (SELs). For the purpose of calculating SEL, three specific activities are considered:

- Launch related activities at the nest
- Flight of the aircraft including climb, en route, delivery, and descent at various altitudes and speeds
- Recovery related activities at the nest

3.4.1 General Assumptions

The following assumptions have been made in the application of acoustical data unless noted otherwise.

Sound transmission between the noise source and the receiver is solely a function of distance with no additional atmospheric attenuation effects.

In this analysis, the knowns include reference sound levels at known distances. Those reference levels will be adjusted for spherical spreading to develop the sound levels at various points. For a stationary point source, the relationship of the level at point i (L_i) to a reference level is provided in Equation (4):

$$L_i = L_R + 20 \times \log_{10} \left(\frac{Dist_R}{Dist_i} \right), dB \quad (4)$$

where L_R is the measured reference level, $Dist_R$ is the distance between the reference level measurement location and the sound source, and $Dist_i$ is the distance between the sound source and Point i . $Dist_R$ and $Dist_i$ must be in the same units of distance. Moving sources will be addressed Section 3.4.3.

Sound transmits equally in all directions.

Sound transmits equally in all directions relative to the noise source (e.g., the L_{Amax} 10 meters off the nose of the aircraft is the same as 10 meters below the aircraft, 10 meters to the side of the aircraft and 10 meters to the rear of the aircraft).

3.4.2 Launch

Two sets of measurements are provided for launch. One measurement location was positioned on sideline (lateral) of the aircraft's flightpath, and one was positioned under the flight path (flyover). Of the two, the sideline values appear more appropriate than the flyover because a) the distance associated with the former is more clearly defined, and b) the former will propagate a more conservative estimate throughout the rest of the analysis. The launch noise sources are assumed to be a

stationary point source, occurring once for each aircraft departure. Sound exposure level for a given point i (SEL_i) located a specific distance ($Dist_i$) in feet from this particular launcher will be based on spherical spreading of a point source and calculated with Equation (5), where 75.5 dB was the measured SEL of a launch 50 feet from the launcher as indicated in Table 1. It is assumed that the launcher apparatus dominates the sideline noise with minimal contribution from the UA and therefore the equation is set up for a stationary source.

$$SEL_i = 75.5 + 20 \times \log_{10} \left(\frac{50}{Dist_i} \right), dB \quad (5)$$

3.4.3 Aircraft Flight

The applicant's aircraft is fixed wing and therefore must continue to move to be airborne. Flight of the aircraft in still air is anticipated to be in the range of 40 to 60 knots.⁹ Sound exposure level for a given point i (SEL_i) with the aircraft flying directly overhead at altitude (Alt_i) in feet and a speed (V_i) in knots, will be calculated based on the guidance in *14 CFR Part 36 Appendix J, Section J36.205 Detailed Data Correction Procedures*.¹⁰ It should be noted that the equations presented in this Section 3.4.3 are only applicable for an aircraft that is moving relative to a stationary receptor.

In particular, the sound exposure level adjustment for the altitude defined in 14 CFR Part 36 for a moving aircraft, is presented here as Equation (6).

$$\Delta J_1 = 12.5 \times \log_{10} \left(\frac{H_A}{H_T} \right), dB \quad (6)$$

Where ΔJ_1 is the quantity in decibels that must be algebraically added to the measured SEL to adjust for a level flight path at an altitude differing from the measured altitude; H_A is the height, in feet, of the vehicle when directly over the noise measurement point; H_T is the height of the vehicle during the measurement (or reference height), and the constant (12.5) accounts for the effects on spherical spreading and duration from the off-reference altitude.

The sound exposure level adjustment for speed, as defined in 14 CFR Part 36, is presented here as Equation (7).

$$\Delta J_3 = 10 \times \log_{10} \left(\frac{V_{RA}}{V_R} \right), dB \quad (7)$$

Where ΔJ_3 is the quantity in decibels that must be algebraically added to the measured SEL noise level to correct for the influence of the adjustment of the reference speed on the duration of the measured flyover event as perceived at the noise measurement station, V_R is the reference speed, and V_{RA} is the adjusted speed.

To estimate the sound exposure level of the UA flying en route the measured sound exposure level made during delivery will be used. As shown in Table 1, the SEL is 68.1 dB measured when the vehicle was 56 feet high traveling at approximately 45 knots; therefore, adapting that measurement to the en

⁹ Various documents provide various speed ranges. This range represents the lower and upper bounds mentioned.

¹⁰ [14 CFR Part 36 Noise Standards: Aircraft Type And Airworthiness Certification](#)

route condition when the UA is flying at an Altitude of Alt_i feet AGL and V_i knots can be made using Equation (8) to arrive at an estimate SEL_i dB for that phase of the flight.

$$SEL_i = 68.1 + 12.5 \times \log_{10} \left(\frac{56}{Alt_i} \right) + 10 \times \log_{10} \left(\frac{45}{V_i} \right), dB \quad (8)$$

3.4.4 Recovery

The applicant's aircraft is recovered by catching a wire positioned approximately 36 feet AGL, and then the aircraft rapidly decelerates and decreases in altitude until it comes to rest on a designated surface. The recovery sources are assumed to be a stationary point source, occurring once for each aircraft arrival. Similar to the en route noise, to estimate the sound exposure level at a given point i (SEL_i) located at a specific distance ($Dist_i$) in feet from the recovery device will be based on spherical spreading of a point source. Equation (9) calculates the recovery SEL_i as a function of distance from the recovery device where 72.8 dB was measured 59.9 feet from the recovery mechanism.

$$SEL_i = 72.8 + 20 \times \log_{10} \left(\frac{59.9}{Dist_i} \right), dB \quad (9)$$

3.5 Proposed DNL Estimation Methodology

The number of operations overflying a particular receiver's location on the ground will vary based on the proposed operating area and demand. For a given receiver location i , and a single instance of sound source A , the SEL for that sound source SEL_{iA} is (energy) summed for the average annual daily number of DNL daytime equivalent operations ($N_{DNL,iA}$) to compute the DNL, or equivalently, by Equation (10).

$$DNL_{iA} = SEL_{iA} + 10 \times \log_{10}(N_{DNL,iA}) - 49.4, (dB) \quad (10)$$

The above equation applies to an SEL value representing one noise source such as an UA launch or an UA recovery. For cases where a particular receiver would be exposed to multiple sound sources (A through Z), the complete DNL at that point would be calculated with Equation (11).

$$DNL_i = 10 \times \log_{10} \left(10^{\left(\frac{DNL_{iA}}{10}\right)} + 10^{\left(\frac{DNL_{iB}}{10}\right)} + \dots + 10^{\left(\frac{DNL_{iZ}}{10}\right)} \right), (dB) \quad (11)$$

For each of the conditions presented below, results will be presented in tabular format with the estimated DNL.

3.5.1 DNL for Launch Operations

The launch and climb process includes accelerating the UA to initial airspeed via a launcher and then having the UA climb at an angle of eight or more degrees. Additional details regarding the nominal launch profile are discussed in Section 2.1.2.1.

Launch operations will be represented by two sound levels provided by Zipline materials. First, the launch will be treated as a stationary source, creating a single noise event for each aircraft departure using the relationships in Section 3.4.2. Second, the aircraft itself will be treated as it moves along its flight path until the en route portion, assumed to be when it reaches an altitude of 250 ft AGL, using the relationships in Section 3.4.3.

The materials provided by Zipline indicate that for any single departure, the UA will be launched on one of two flight paths, depending on the winds. Since the launcher will be aligned in one of two directions, the initial flight paths, including the turns to the initial heading, are expected to be consistent from flight to flight.

3.5.2 DNL for En Route

En route includes the UA flying to and from the nest to delivery sites as discussed in Section 2.1.2.2. A representative receiver will be positioned directly under the flight path, and the DNL will be calculated based on the altitude and speed-adjusted delivery SEL calculated in Section 3.4.3 and Equation (8). Operations will be based on representative numbers defined in relevant materials and generally assume that a receiver under the flight path will be overflown by the UA while it is traveling both outbound and inbound for a single delivery.

In instances where the UA may enter a holding pattern, DNL may be calculated consistent with the methodology used for en route flight. However, during holding, the UA may overfly a single location multiple times outbound or inbound while making a delivery, and the number of operations experienced during holding may exceed the number of delivery operations. In these instances, operations under the flight path over a receiver may vary based on information regarding the frequency of holding operations defined in relevant materials and may include additional overflights of the UA beyond typical inbound and outbound delivery operations.

3.5.3 DNL for Delivery Sites

Delivery includes delivery of a package by the UA to a delivery site as discussed in Section 2.1.2.3. As the specific delivery sites and flight path to and from a specific delivery site is likely not known at the time of the noise analysis, the sound exposure will be represented by the noise level associated with the vehicle during delivery and applied throughout a radius surrounding the delivery site where the UA could be at the lowest altitude and slowest speed. The information shown in Figure 3 and Section 2.1.2.3 indicates this area could be on the order of 1 to 1.5 statute miles.

A representative receiver will be placed under the flight path at the delivery site, and the SELs and DNL will be calculated as a function of altitude and speed as detailed in Section 3.4.3. Results will be presented in a tabular format for varying numbers of deliveries.

3.5.4 DNL for Recovery Operations

Recovery operations will be represented by two sound levels provided by Zipline. First, aircraft will fly a flight path from en route conditions (Section 2.1.2.2) and descend to the recovery apparatus at an assumed 36 ft AGL (Section 2.1.2.4). Second, the actual recovery event will be treated as a stationary source, creating a single noise event for each aircraft recovered using the relationships in Section 3.4.4.

3.5.5 DNL for Nest Activities

The launch and recovery operations discussed in Sections 3.5.1 and 3.5.4 are anticipated to occur at the same location. Therefore, the results for both will be calculated for a single set of receptors. Operations will be assumed to be “head-to-head” in which case the launch and the recovery flight paths will be the same.

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4 Noise Exposure Estimate Results

This section presents the estimated noise exposure for Zipline’s proposed operations for a given set of average annual day (AAD) deliveries. The values presented are in tabular format and use of the table requires estimating the number of DNL Equivalent deliveries associated with the nest. One delivery includes the outbound launch and inbound recovery and is representative of two operations. The DNL Equivalent deliveries, $N_{DNL,i}$ as described in Section 3.1, is presented below as Equation (12)

$$Deliveries_{DNL,i} = Deliveries_{Day} + 10 \times Deliveries_{Night} \quad (12)$$

$Deliveries_{Day}$ are between 7 AM and 10 PM and $Deliveries_{Night}$ are 10 PM and 7 AM.¹¹ If a portion of a delivery occurs in the nighttime hours (either launch or recovery) then it should be counted within $Deliveries_{Night}$.

For estimating noise exposure, the noise levels for each flight phase should be considered separate based on the level of proposed operations for a given location. If a particular location is at the transition of two flight phases (for example, completing climb and starting en route), then the louder of the two results should be used.

4.1 Noise Exposure for Operations at the Nest

For operations at the nest, the UA-related noises include the launch and recovery. To provide a conservative view, all operations are assumed to be on the same flight path operating in opposite directions.

Table 2 presents for a given number of daily average DNL Equivalent deliveries (including the launch, climb, descent, and recovery as detailed in Section 2.1.2), the estimated extent of DNL 45 dB, 50 dB, 55 dB, 60 dB, and 65 dB under the flight paths for a given orientation of the launcher relative to the nest extents as described in Section 3.2. Table 3 presents for a given number of deliveries (including the launch, climb, descent, and recovery), the estimated extent of DNL 45 dB, DNL 45 dB, 50 dB, 55 dB, 60 dB, and 65 dB to the sideline of the nest for a given orientation of the launcher and nest extents. The analyses presented in Table 2 and Table 3 were rounded up conservatively to the nearest 25 ft intervals. The actual noise levels, should they be calculated with greater precision or measured, are anticipated to be within the estimated extents depicted.¹²

The subsections that follow discuss how to interpret the data contained in Table 2 and Table 3 for application to estimating nest noise exposure for two circumstances.

¹¹ Discussion of modification of this process for use in California with the CNEL metric is discussed in Section 3.1.

¹² The calculation of the equations presented in Section 3 require that distance is provided. The DNL levels were calculated at 25 foot intervals from 25 to 1,925 ft. The interval of 25 feet was selected based on professional judgement considering the anticipated use of these tables for estimating noise at locations outside of the nest.

Table 2. Estimated Extent of Noise Exposure from the Nest per Number of Deliveries - Under Flight Paths

Number of DNL Equivalent Deliveries Served by Nest		Estimated Extents, feet, for				
Average Daily	Annual	DNL 45 dB	DNL 50 dB	DNL 55 dB	DNL 60 dB	DNL 65 dB
<= 1	<= 365	25	25	25	25	25
<= 5	<= 1,825	25	25	25	25	25
<= 10	<= 3,650	50	25	25	25	25
<= 15	<= 5,475	50	25	25	25	25
<= 20	<= 7,300	75	25	25	25	25
<= 40	<= 14,600	100	50	25	25	25
<= 60	<= 21,900	150	50	25	25	25
<= 80	<= 29,200	200	75	50	25	25
<= 100	<= 36,500	225	75	50	25	25
<= 120	<= 43,800	275	100	50	25	25
<= 140	<= 51,100	325	100	50	25	25
<= 160	<= 58,400	375	125	50	25	25
<= 180	<= 65,700	400	150	50	25	25
<= 200	<= 73,000	450	150	75	25	25
<= 220	<= 80,300	500	175	75	25	25
<= 240	<= 87,600	525	175	75	50	25
<= 260	<= 94,900	575	200	75	50	25
<= 280	<= 102,200	725	200	75	50	25
<= 300	<= 109,500	750	225	75	50	25
<= 340	<= 124,100	800	250	100	50	25
<= 360	<= 131,400	825	275	100	50	25
<= 380	<= 138,700	850	275	100	50	25
<= 400	<= 146,000	925	300	100	50	25
<= 420	<= 153,300	975	325	100	50	25
<= 440	<= 160,600	1000	325	100	50	25
<= 460	<= 167,900	1075	350	125	50	25
<= 480	<= 175,200	1150	350	125	50	25
<= 500	<= 182,500	1200	350	125	50	25

Notes:

- a) One delivery includes the outbound launch and inbound recovery and is representative of two operations.
- b) If a value for deliveries is not specifically defined in in this table, use the next highest value. For example, if there are 50 average daily DNL Equivalent deliveries, use the entry for 60 average daily DNL Equivalent deliveries.

Table 3. Estimated Extent of Noise Exposure from the Nest per Number of Deliveries - Sideline

Number of DNL Equivalent Deliveries Served by Nest		Estimated Extents, feet, for				
Average Daily	Annual	DNL 45 dB	DNL 50 dB	DNL 55 dB	DNL 60 dB	DNL 65 dB
<= 1	<= 365	25	25	25	25	25
<= 5	<= 1,825	25	25	25	25	25
<= 10	<= 3,650	50	25	25	25	25
<= 15	<= 5,475	50	25	25	25	25
<= 20	<= 7,300	50	25	25	25	25
<= 40	<= 14,600	75	50	25	25	25
<= 60	<= 21,900	75	50	25	25	25
<= 80	<= 29,200	100	50	25	25	25
<= 100	<= 36,500	100	50	50	25	25
<= 120	<= 43,800	100	75	50	25	25
<= 140	<= 51,100	125	75	50	25	25
<= 160	<= 58,400	125	75	50	25	25
<= 180	<= 65,700	150	75	50	25	25
<= 200	<= 73,000	150	75	50	25	25
<= 220	<= 80,300	150	75	50	25	25
<= 240	<= 87,600	150	100	50	25	25
<= 260	<= 94,900	175	100	50	25	25
<= 280	<= 102,200	175	100	50	25	25
<= 300	<= 109,500	175	100	50	50	25
<= 340	<= 124,100	200	100	50	50	25
<= 360	<= 131,400	200	100	75	50	25
<= 380	<= 138,700	200	125	75	50	25
<= 400	<= 146,000	225	125	75	50	25
<= 420	<= 153,300	225	125	75	50	25
<= 440	<= 160,600	225	125	75	50	25
<= 460	<= 167,900	225	125	75	50	25
<= 480	<= 175,200	225	125	75	50	25
<= 500	<= 182,500	250	125	75	50	25

Notes:

- a) One delivery includes the outbound launch and inbound recovery and is representative of two operations.
- b) If a value for deliveries is not specifically defined in in this table, use the next highest value. For example, if there are 50 average daily DNL Equivalent deliveries, use the entry for 60 average daily DNL Equivalent deliveries.

4.1.1 Nest Flight Paths Are Known to Be on a Single Axis

If the initial launch/climb flight paths and recovery paths are known and are parallel (i.e., on a single axis, with one heading and its 180-degree counterpart), analogous to an airport with a single runway, then the noise extents from nest operations can be represented as a rectangular area.

The length of the rectangle is represented by the distance/noise levels presented in Table 2 added to the nest extent sides that the flight paths cross. The “under flight path” levels and distances from Table 2 would be added to both sides of the nest extents and create the long sides of the rectangle along the flight path. The width of the rectangle is represented by the distance/noise levels presented in Table 3 added to the lateral sides of the nest extents, which represent those sides parallel to the flight path.

Figure 9 presents guidance on constructing a rectangle representing the extent of various noise exposure levels and orient the nest extents relative to the flight paths based on the data presented in Table 2 and Table 3.

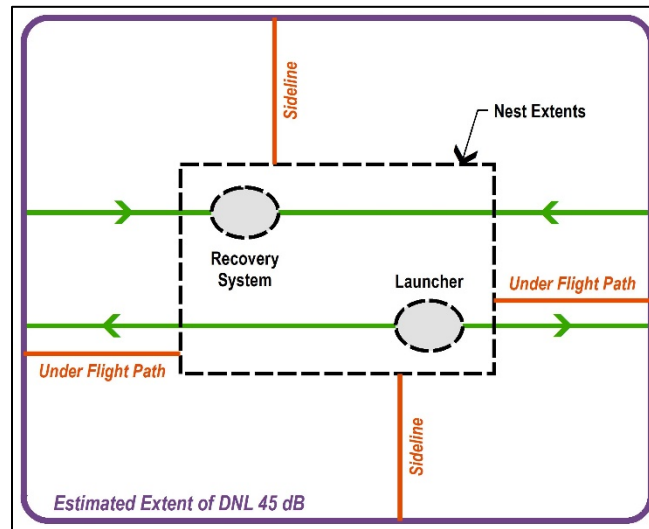


Figure 9. Demonstration of Determining Extent of DNL 45 dB at Nest with Flight Paths at 180 Degrees

Source: HMMH

4.1.2 Nest Flight Paths are Not Known or Varied

For situations in which the flight paths are not known or are expected to be more complicated than presented in Section 4.1.1, a conservative rectangular area can be constructed to represent the anticipated extent of noise exposure. Such situations may include a) the orientation of the launch and recovery infrastructure are not known, b) launch and recovery will not occur in opposite directions/single axis, or c) flight paths from the nest have not been determined. The polygon is developed by applying the distance “Under Flight Path” provided in Table 2 to all sides of the nest extents. Figure 10 presents guidance on how to apply the “Under Flight Path” provided in Table 2 relative to a rectangular nest extent.

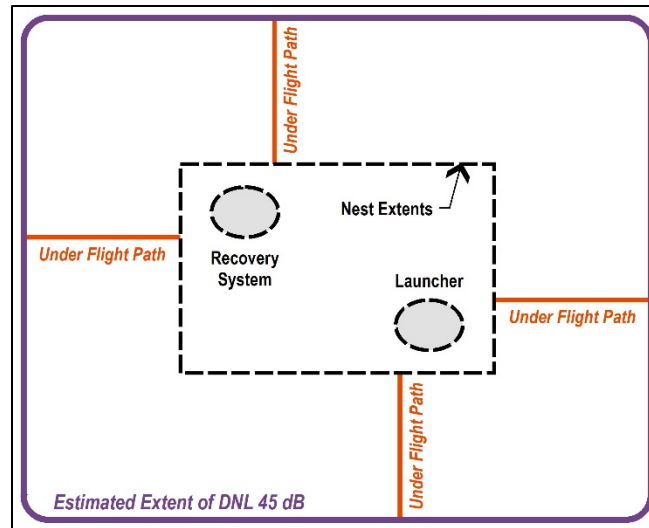


Figure 10. Demonstration of Determining Extent of DNL 45 dB at a Nest for Flight Paths are Not Known or Varied
 Source: HMMH

4.2 Noise Exposure under En Route Paths

For en route conditions, the UA is expected to fly the same outbound flight path between the nest and the delivery site and inbound flight path back to the nest (See Section 2.1.2 and Figure 3). Therefore, each location under the en route path would be overflowed twice for each delivery served by the respective overhead en route path.

In addition, there is expected to be at least one location near a nest in which all flight paths will intersect. For Zipline's operations, all departures and arrivals would always be funneled through the same point prior to continuing to the delivery site or to the recovery. This is where the maximum expected concentration of operations should occur at en route altitudes between 250ft - 400ft AGL.¹³

Table 4 presents the estimated DNL for a location on the ground directly under an en route path for various counts of daily average DNL Equivalent deliveries. The en route noise calculated for each delivery includes both the inbound and outbound traversal of the en route path.

¹³ Zipline October 20, 2021

Table 4. Estimated DNL Directly Under En Route Flight Paths at Various Altitudes and Ground Speeds

Number of DNL Equivalent Deliveries Served by Route		Day Night Average Sound Level (DNL), dB					
		Altitude 130 ft AGL		Altitude 250 ft AGL		Altitude 400 ft AGL	
Average Daily	Annual	40 kts	60 kts	40 kts	60 kts	40 kts	60 kts
<= 1	<= 365	17.7	15.9	14.1	12.4	11.6	9.8
<= 5	<= 1,825	24.7	22.9	21.1	19.4	18.6	16.8
<= 10	<= 3,650	27.7	25.9	24.1	22.4	21.6	19.8
<= 15	<= 5,475	29.4	27.7	25.9	24.1	23.3	21.6
<= 20	<= 7,300	30.7	28.9	27.1	25.4	24.6	22.8
<= 40	<= 14,600	33.7	31.9	30.2	28.4	27.6	25.8
<= 60	<= 21,900	35.5	33.7	31.9	30.2	29.4	27.6
<= 80	<= 29,200	36.7	35.0	33.2	31.4	30.6	28.9
<= 100	<= 36,500	37.7	35.9	34.1	32.4	31.6	29.8
<= 120	<= 43,800	38.5	36.7	34.9	33.2	32.4	30.6
<= 140	<= 51,100	39.1	37.4	35.6	33.8	33.0	31.3
<= 160	<= 58,400	39.7	38.0	36.2	34.4	33.6	31.9
<= 180	<= 65,700	40.2	38.5	36.7	34.9	34.1	32.4
<= 200	<= 73,000	40.7	38.9	37.1	35.4	34.6	32.8
<= 220	<= 80,300	41.1	39.3	37.6	35.8	35.0	33.2
<= 240	<= 87,600	41.5	39.7	37.9	36.2	35.4	33.6
<= 260	<= 94,900	41.8	40.1	38.3	36.5	35.7	34.0
<= 280	<= 102,200	42.2	40.4	38.6	36.8	36.1	34.3
<= 300	<= 109,500	42.5	40.7	38.9	37.1	36.4	34.6
<= 340	<= 124,100	43.0	41.2	39.4	37.7	36.9	35.1
<= 360	<= 131,400	43.2	41.5	39.7	37.9	37.1	35.4
<= 380	<= 138,700	43.5	41.7	39.9	38.2	37.4	35.6
<= 400	<= 146,000	43.7	41.9	40.2	38.4	37.6	35.8
<= 420	<= 153,300	43.9	42.2	40.4	38.6	37.8	36.1
<= 440	<= 160,600	44.1	42.4	40.6	38.8	38.0	36.3
<= 460	<= 167,900	44.3	42.6	40.8	39.0	38.2	36.4
<= 480	<= 175,200	44.5	42.7	40.9	39.2	38.4	36.6
<= 500	<= 182,500	44.7	42.9	41.1	39.4	38.6	36.8

Notes:

- a) One delivery includes an outbound operation and inbound operation along the same flight path, thus two overflights.
- b) If a value for deliveries is not specifically defined in in this table, use the next highest value. For example, if there are 50 average daily deliveries, use the entry for 60 average daily deliveries.
- c) If a value for altitude or speed is not specifically defined in in this table, use the next lowest value. For example, if the UA is anticipated to operate at an altitude of 190 ft AGL at 45 kts, use the entry for 130 ft AGL and 40 kts.

In some instances, the UA may overfly locations not consistent with the en route circumstances and associated results presented in Table 4. This may include maneuvers such as en route static or ad-hoc holding patterns. For these circumstances, Table 5 presents the equations for calculating the estimated DNL for a receiver directly under a specified given number of DNL Equivalent average daily individual overflights, defined as N_o .



Table 5. Estimated DNL Directly Under Overflights

Altitude and Speed of Overflight		DNL for 1 Overflight Between 7 AM and 10 PM (dB)	DNL equation for the number of DNL Equivalent Overflights
Altitude 60 ft AGL	40 kts	18.9	$10 \times \log_{10}(N_o) + 18.9$
	60 kts	17.1	$10 \times \log_{10}(N_o) + 17.1$
Altitude 130 ft AGL	40 kts	14.7	$10 \times \log_{10}(N_o) + 14.7$
	60 kts	12.9	$10 \times \log_{10}(N_o) + 12.9$
Altitude 250 ft AGL	40 kts	11.1	$10 \times \log_{10}(N_o) + 11.1$
	60 kts	9.4	$10 \times \log_{10}(N_o) + 9.4$
Altitude 400 ft AGL	40 kts	8.6	$10 \times \log_{10}(N_o) + 8.6$
	60 kts	6.8	$10 \times \log_{10}(N_o) + 6.8$

Notes:

a) The DNL value for a given number of average DNL Equivalent Operations, N_o , can be found by using the equations associated with operation of the UA at a specified altitude and speed interval. In this case, one operation represents a single overflight.

b) If a value for altitude or speed is not specifically defined in in this table, use the next lowest value. For example, if the UA is anticipated to operate at an altitude of 190 ft AGL at 45 kts, use the entry for 130 ft AGL and 40 kts.

4.3 Noise Exposure for Operations under Delivery

Table 6 presents DNL values over a range of potential daily average DNL Equivalent delivery counts at a delivery site. The DNL values present what is anticipated to be the loudest noise exposure level that could be associated with a UA during its delivery attempts during the course of an average 24-hour period. Also included in Table 6 is the equation for calculating the estimated DNL for a specific number of daily average DNL Equivalent delivery counts at a delivery site, defined as N_d , for instances where the number of deliveries may fall between the range of presented delivery count intervals.

It should be noted that the UA may fly in a circular and then an oval pattern near the delivery site as it approaches the drop zone, and may make multiple turns as it leaves the drop zone. Therefore, a multiple of the number of Deliveries/Flybys could be considered if the levels in Table 6 are applied beyond the immediate designed 40 foot by 40-foot drop zone. As discussed in 2.1.2 and presented in Figure 11, such patterns are generally within 1 and 1.5 statute miles of the designator delivery site.¹⁴

¹⁴ A single delivery drop at 60 feet is anticipated to be of greater SEL and DNL than two pattern passes at 130 feet AGL ground speed and equivalent to six pattern passes at 250 feet AGL. This general comparison assumes delivery and pattern passes are at the same speed.

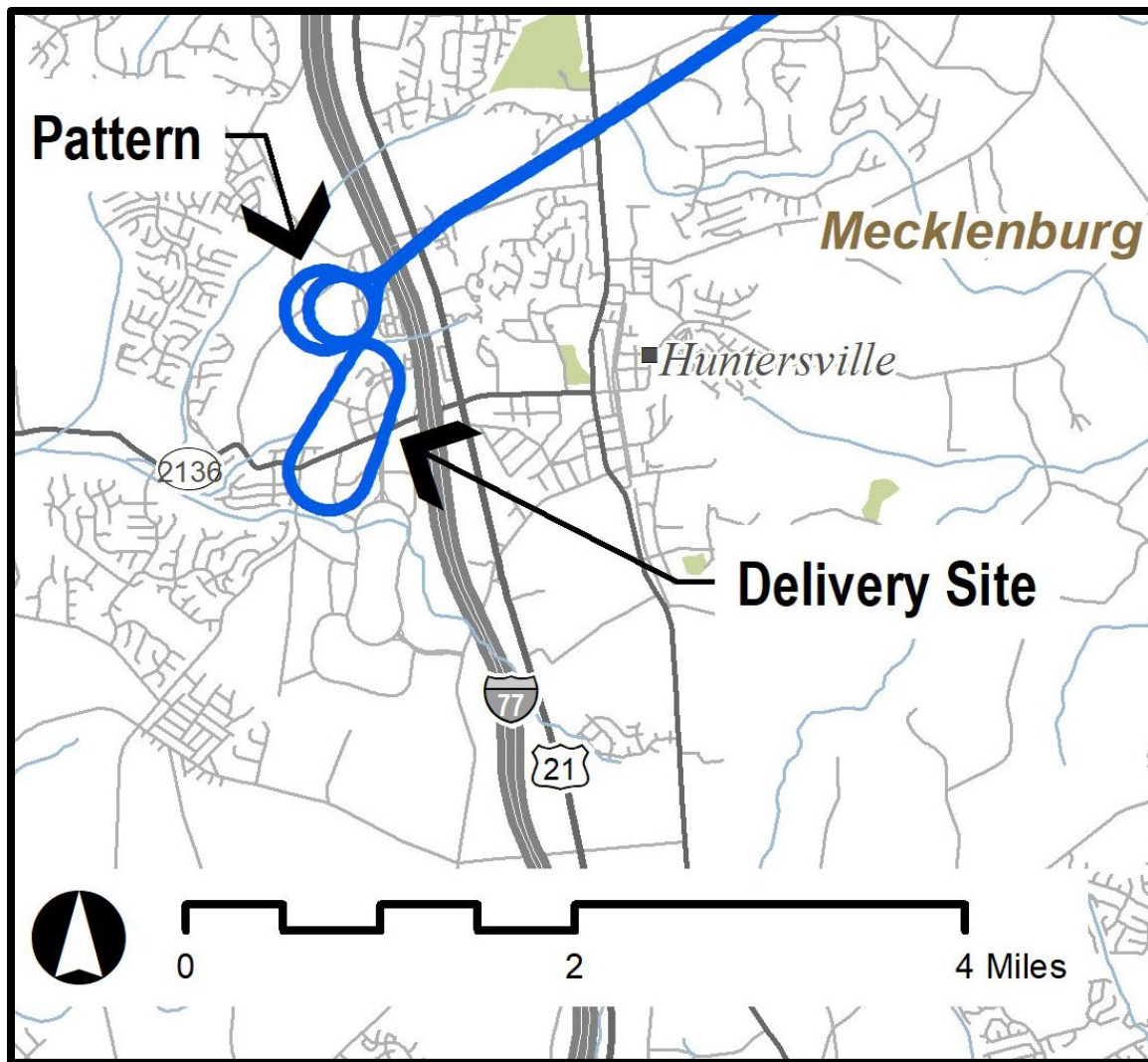


Figure 11. Annotated Example Delivery Flight Path around Delivery Site

Sources: Zipline, October 29, 2021; Annotations by HMMH

Table 6. Estimated Maximum DNL at Delivery Site

Number of DNL Equivalent Deliveries, Delivery Attempts, and Flybys		60 ft AGL 40 knot Ground Speed Estimated DNL (dB)
Average Daily	Annual	
<= 1	<= 365	18.9
<= 5	<= 1,825	25.9
<= 10	<= 3,650	28.9
<= 15	<= 5,475	30.6
<= 20	<= 7,300	31.9
<= 40	<= 14,600	34.9
<= 60	<= 21,900	36.7
<= 80	<= 29,200	37.9
<= 100	<= 36,500	38.9
<= 120	<= 43,800	39.7
<= 140	<= 51,100	40.3
<= 160	<= 58,400	40.9
<= 180	<= 65,700	41.4
<= 200	<= 73,000	41.9
<= 220	<= 80,300	42.3
<= 240	<= 87,600	42.7
<= 260	<= 94,900	43.0
<= 280	<= 102,200	43.3
<= 300	<= 109,500	43.6
<= 340	<= 124,100	44.2
<= 360	<= 131,400	44.4
<= 380	<= 138,700	44.7
<= 400	<= 146,000	44.9
<= 420	<= 153,300	45.1
<= 440	<= 160,600	45.3
<= 460	<= 167,900	45.5
<= 480	<= 175,200	45.7
<= 500	<= 182,500	45.9
N_d	$N_d \times 365$	$10 \times \log_{10}(N_d) + 18.9$
Notes:		
a) One delivery includes the outbound launch and inbound recovery.		
b) If a value is not specifically in in this table, use the next highest. For example, if there we are 50 daily operations, use the entry for 60 daily operations.		

Appendix D
Non-Standard Noise Methodology Memos



Federal Aviation Administration

Memorandum

Date: January 11, 2022

To: Don Scata, Noise Division Manager, Office of Environment and Energy (AEE-100)

From: Mike Millard, Flight Standards (AFS), General Aviation Operations Branch, AFS-830

Subject: Environmental Assessment (EA) Noise Methodology Approval Request for Zipline International Inc. Commercial Package Delivery Operations with the Sparrow UA from Kannapolis, NC

FAA Office of Flight Standards (AFS) requests FAA Office of Environmental and Energy, Noise Division (AEE-100) approval of the noise methodology to be used for the Environmental Assessment (EA) for Zipline International, Inc. (Zipline) operations using the Sparrow unmanned aircraft (UA) in Kannapolis, NC to provide package delivery services as a 14 CFR Part 135 operator as described below.

As required under the National Environmental Policy Act (NEPA), the FAA must consider the potential for environmental impacts in informing the agency's decision to approving Federal actions, including the potential for noise impacts as detailed in FAA Order 1050.1F.

As the FAA does not currently have a standard approved noise model for UA, this memo serves as a request for written approval from AEE-100 to use the methodology proposed in the following sections to support the noise analysis for this EA.

Description of Aircraft and Proposed Operations

AFS is evaluating Zipline's proposed commercial package delivery operations using the Sparrow UA from a single central distribution center (a "nest") located in Kannapolis, NC serving an operating area in the Charlotte, NC Metropolitan Area. Approval of a Federal Action providing Zipline's air carrier Operations Specifications (OpSpecs) is required before these operations can occur.

Zipline is proposing to perform package delivery operations from the nest connecting to a supporting route network within the proposed operating area to transport packages to delivery locations ("delivery sites"); such as medical centers, health facilities, and private homes, in sixteen surrounding communities.

The Sparrow UA is a fixed-wing design with a maximum takeoff weight listed as 49.3 pounds. General operating airspeeds of the UA are expected to be in the range of 45 to 60 knots. The UA is launched via catapult at the nest and then climbs to en route altitude, at which point it navigates along a defined path from the nest to the intended delivery site. The en route portion of the flight would generally be operated at an altitude of 250 feet Above Ground Level (AGL) and is always below an altitude of 400 feet AGL. Approaching the delivery site, the UA flies a pattern near the delivery point, descends to 60 feet AGL, drops a package via parachute at a pre-defined drop zone, climbs back to en route altitude, and then flies along a defined path for recovery at the nest via a cable driven recovery system. Zipline projects operating a maximum of 20 delivery flight operations per day during daytime hours (7 AM to 10 PM) from the Kannapolis nest under the scope of this proposed action.

Noise Analysis Methodology

AFS requests use of the noise analysis methodology described in HMMH Report No. 309990.003-4 for the “Noise Assessment for Zipline Proposed Package Delivery Operations with Sparrow Unmanned Aircraft” dated January 5, 2022.



Federal Aviation Administration

Memorandum

Date: January 11, 2022

To: Mike Millard, Flight Standards (AFS), General Aviation Operations Branch, AFS-830

From: Don Scata, Manager, Noise Division, Office of Environment and Energy (AEE-100)

Subject: Environmental Assessment (EA) Noise Methodology Approval Request for Zipline International, Inc. Commercial Package Delivery Operations with the Sparrow UA from Kannapolis, NC

The Office of Environment and Energy, Noise Division (AEE-100), has reviewed the proposed non-standard noise modeling methodology to be used for Zipline International, Inc. (Zipline) operations using the Sparrow unmanned aircraft (UA) in Kannapolis, North Carolina. This request is in support of an Environmental Assessment (EA) for Zipline to provide package delivery services as a 14 CFR Part 135 operator in Kannapolis and an operating area in the Charlotte, NC Metropolitan Area.

The Proposed Action is to use the Sparrow UA from a single central distribution center, referred to as a “nest”, connecting to a supporting route network to deliver packages to potential delivery locations (“delivery sites”) such as medical centers, health facilities, and private homes within the proposed operating area to sixteen surrounding communities. Typical operations of the UA will consist of departure from the nest via launch by catapult and a quick climb to an approximate en route altitude between 250-400 feet above ground level (AGL). The UA will then navigate along a defined path from the nest to the intended delivery site. Approaching the delivery site, the UA will fly a pattern near the delivery point, descend to 60 feet AGL, and drop a package via parachute within a pre-defined drop zone. Following delivery, the UA will climb back to en route altitude, fly along a defined path back to the nest, and then be recovered at the nest via a cable driven arrestor system. Zipline projects operating a maximum of 20 delivery flight operations per day during daytime hours (7 AM to 10 PM) from the Kannapolis nest under the scope of this proposed action.

As the FAA does not currently have a standard approved noise model for assessing UA, and in accordance with FAA Order 1050.1F, all non-standard noise analysis in support of the noise impact analysis for the National Environmental Policy Act (NEPA) must be approved by AEE. This letter serves as AEE’s response to the method developed in in HMMH Report No. 309990.003-4 for the “Noise Assessment for Zipline Proposed Package Delivery Operations with Sparrow Unmanned Aircraft” dated January 5, 2022.

The proposed methodology appears to be adequate for this analysis; therefore, AEE concurs with the methodology proposed for this project. Please understand that this approval is limited to this particular Environmental Review, location, vehicle, and circumstances. Any additional projects using this or other methodologies or variations in the vehicle will require separate approval.

Appendix E
EJSCREEN Report

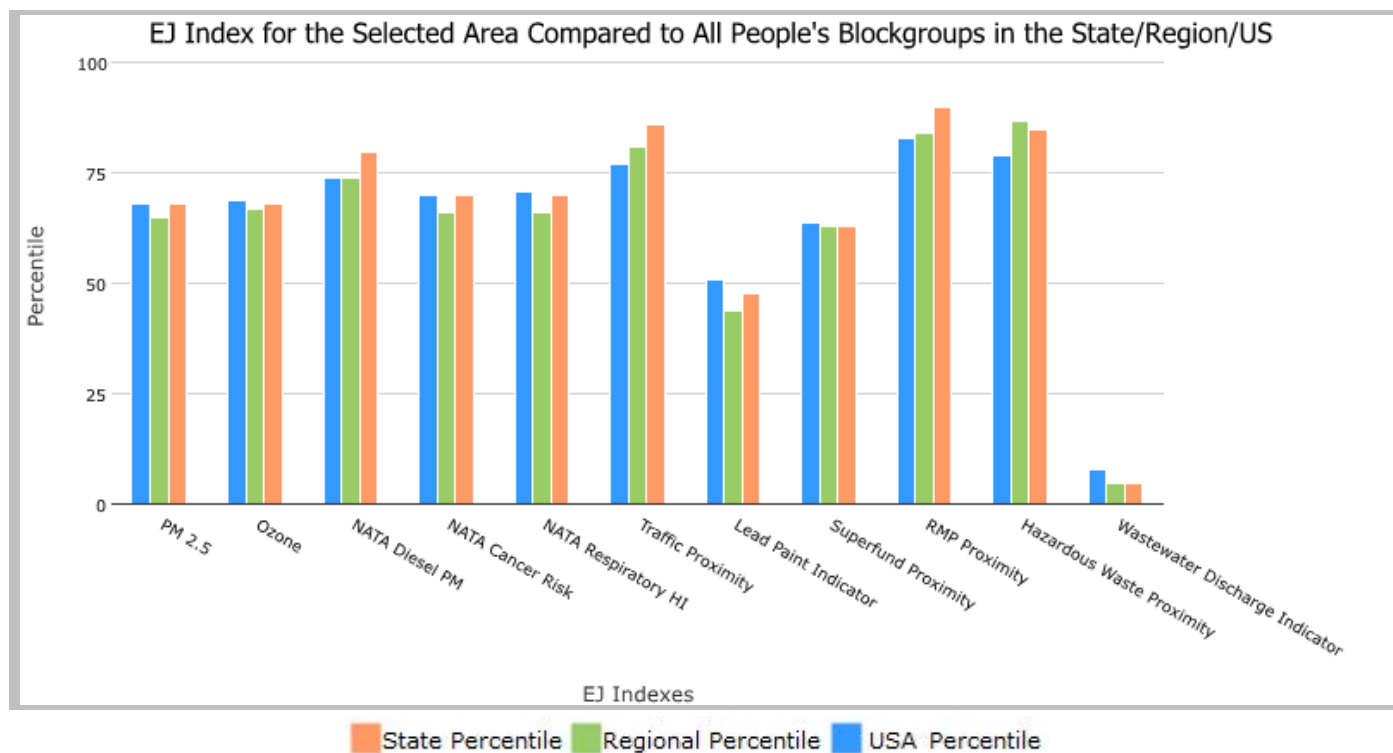
1 mile Ring around the Corridor, NORTH CAROLINA, EPA Region 4

Approximate Population: 160,823

Input Area (sq. miles): 257.41

Zipline CLT Ops Area

Selected Variables	State Percentile	EPA Region Percentile	USA Percentile
EJ Indexes			
EJ Index for PM2.5	68	65	68
EJ Index for Ozone	68	67	69
EJ Index for NATA* Diesel PM	80	74	74
EJ Index for NATA* Air Toxics Cancer Risk	70	66	70
EJ Index for NATA* Respiratory Hazard Index	70	66	71
EJ Index for Traffic Proximity and Volume	86	81	77
EJ Index for Lead Paint Indicator	48	44	51
EJ Index for Superfund Proximity	63	63	64
EJ Index for RMP Proximity	90	84	83
EJ Index for Hazardous Waste Proximity	85	87	79
EJ Index for Wastewater Discharge Indicator	5	5	8



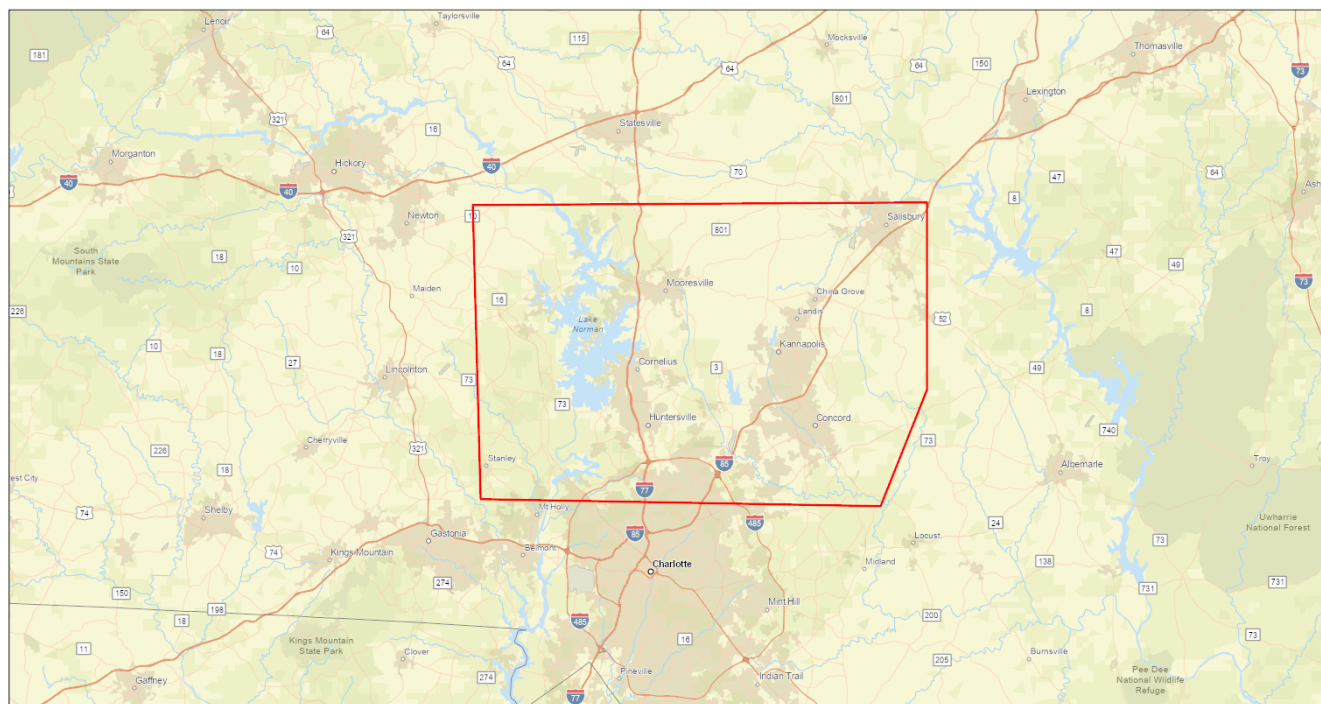
This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.

1 mile Ring around the Corridor, NORTH CAROLINA, EPA Region 4

Approximate Population: 160,823

Input Area (sq. miles): 257.41

Zipline CLT Ops Area



November 24, 2021

— Zipline CLT Ops Area

1:577,791
0 5 10 20 mi
0 5 10 20 km

Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, OpenStreetMap contributors, and the GIS User Community

Sites reporting to EPA

Superfund NPL

0

Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)

14

EJSCREEN Report (Version 2020)

1 mile Ring around the Corridor, NORTH CAROLINA, EPA Region 4

Approximate Population: 160,823

Input Area (sq. miles): 257.41

Zipline CLT Ops Area

Selected Variables	Value	State Avg.	%ile in State	EPA Region Avg.	%ile in EPA Region	USA Avg.	%ile in USA
Environmental Indicators							
Particulate Matter (PM 2.5 in $\mu\text{g}/\text{m}^3$)	8.91	8.25	79	8.57	68	8.55	61
Ozone (ppb)	45.9	42.9	90	38	98	42.9	76
NATA* Diesel PM ($\mu\text{g}/\text{m}^3$)	0.435	0.309	81	0.417	60-70th	0.478	50-60th
NATA* Cancer Risk (lifetime risk per million)	38	34	82	36	60-70th	32	70-80th
NATA* Respiratory Hazard Index	0.52	0.46	82	0.52	50-60th	0.44	70-80th
Traffic Proximity and Volume (daily traffic count/distance to road)	260	230	74	350	68	750	54
Lead Paint Indicator (% Pre-1960 Housing)	0.11	0.16	52	0.15	59	0.28	40
Superfund Proximity (site count/km distance)	0.1	0.082	81	0.083	80	0.13	68
RMP Proximity (facility count/km distance)	0.77	0.39	87	0.6	75	0.74	70
Hazardous Waste Proximity (facility count/km distance)	1.5	1.3	71	0.91	82	5	59
Wastewater Discharge Indicator (toxicity-weighted concentration/m distance)	0.017	0.16	89	0.65	88	9.4	82
Demographic Indicators							
Demographic Index	40%	36%	63	37%	61	36%	64
People of Color Population	48%	37%	69	39%	66	39%	65
Low Income Population	33%	36%	48	36%	47	33%	57
Linguistically Isolated Population	2%	2%	70	3%	67	4%	60
Population With Less Than High School Education	10%	13%	49	13%	48	13%	55
Population Under 5 years of age	6%	6%	50	6%	51	6%	48
Population over 64 years of age	11%	15%	32	17%	31	15%	35

* The National-Scale Air Toxics Assessment (NATA) is EPA's ongoing, comprehensive evaluation of air toxics in the United States. EPA developed the NATA to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that NATA provides broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. More information on the NATA analysis can be found at: <https://www.epa.gov/national-air-toxics-assessment>.

For additional information, see: www.epa.gov/environmentaljustice

EJSCREEN is a screening tool for pre-decisional use only. It can help identify areas that may warrant additional consideration, analysis, or outreach. It does not provide a basis for decision-making, but it may help identify potential areas of EJ concern. Users should keep in mind that screening tools are subject to substantial uncertainty in their demographic and environmental data, particularly when looking at small geographic areas. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports. This screening tool does not provide data on every environmental impact and demographic factor that may be relevant to a particular location. EJSCREEN outputs should be supplemented with additional information and local knowledge before taking any action to address potential EJ concerns.

Location: User-specified linear location
 Ring (buffer): 1-miles radius
 Description: Zipline CLT Ops Area

Summary of ACS Estimates		2014 - 2018	
Population		160,764	
Population Density (per sq. mile)		631	
People of Color Population		76,678	
% People of Color Population		48%	
Households		59,338	
Housing Units		65,266	
Housing Units Built Before 1950		3,591	
Per Capita Income		27,706	
Land Area (sq. miles) (Source: SF1)		254.68	
% Land Area		99%	
Water Area (sq. miles) (Source: SF1)		3.07	
% Water Area		1%	

	2014 - 2018 ACS Estimates	Percent	MOE (±)
Population by Race			
Total	160,764	100%	750
Population Reporting One Race	157,045	98%	2,618
White	89,030	55%	547
Black	54,209	34%	760
American Indian	608	0%	137
Asian	7,107	4%	444
Pacific Islander	29	0%	51
Some Other Race	6,061	4%	679
Population Reporting Two or More Races	3,719	2%	222
Total Hispanic Population	10,766	7%	686
Total Non-Hispanic Population	149,998		
White Alone	84,086	52%	527
Black Alone	53,459	33%	760
American Indian Alone	531	0%	137
Non-Hispanic Asian Alone	7,103	4%	444
Pacific Islander Alone	29	0%	51
Other Race Alone	1,480	1%	266
Two or More Races Alone	3,311	2%	222
Population by Sex			
Male	79,392	49%	528
Female	81,372	51%	522
Population by Age			
Age 0-4	9,015	6%	282
Age 0-17	34,799	22%	386
Age 18+	125,964	78%	570
Age 65+	17,722	11%	174

Data Note: Detail may not sum to totals due to rounding. Hispanic population can be of any race.
 N/A means not available. **Source:** U.S. Census Bureau, American Community Survey (ACS) 2014 - 2018

Location: User-specified linear location

Ring (buffer): 1-miles radius

Description: Zipline CLT Ops Area

	2014 - 2018 ACS Estimates	Percent	MOE (±)
Population 25+ by Educational Attainment			
Total	103,615	100%	477
Less than 9th Grade	3,681	4%	161
9th - 12th Grade, No Diploma	7,199	7%	163
High School Graduate	26,772	26%	353
Some College, No Degree	33,927	33%	317
Associate Degree	10,638	10%	164
Bachelor's Degree or more	32,036	31%	291
Population Age 5+ Years by Ability to Speak English			
Total	151,749	100%	722
Speak only English	133,683	88%	590
Non-English at Home ¹⁺²⁺³⁺⁴	18,067	12%	390
¹ Speak English "very well"	10,829	7%	298
² Speak English "well"	4,801	3%	223
³ Speak English "not well"	2,018	1%	276
⁴ Speak English "not at all"	418	0%	121
³⁺⁴ Speak English "less than well"	2,436	2%	301
²⁺³⁺⁴ Speak English "less than very well"	7,237	5%	348
Linguistically Isolated Households*			
Total	1,439	100%	123
Speak Spanish	734	51%	104
Speak Other Indo-European Languages	220	15%	64
Speak Asian-Pacific Island Languages	393	27%	99
Speak Other Languages	92	6%	81
Households by Household Income			
Household Income Base	59,338	100%	234
< \$15,000	6,306	11%	177
\$15,000 - \$25,000	5,393	9%	158
\$25,000 - \$50,000	13,880	23%	210
\$50,000 - \$75,000	12,543	21%	177
\$75,000 +	21,216	36%	243
Occupied Housing Units by Tenure			
Total	59,338	100%	234
Owner Occupied	37,874	64%	219
Renter Occupied	21,464	36%	244
Employed Population Age 16+ Years			
Total	130,003	100%	631
In Labor Force	85,907	66%	548
Civilian Unemployed in Labor Force	6,026	5%	289
Not In Labor Force	44,096	34%	425

Data Note: Detail may not sum to totals due to rounding. Hispanic population can be of anyrace.

N/A means not available. **Source:** U.S. Census Bureau, American Community Survey (ACS)

*Households in which no one 14 and over speaks English "very well" or speaks English only.

Location: User-specified linear location

Ring (buffer): 1-miles radius

Description: Zipline CLT Ops Area

	2014 - 2018 ACS Estimates	Percent	MOE (±)
Population by Language Spoken at Home*			
Total (persons age 5 and above)	148,088	100%	1,003
English	129,560	87%	827
Spanish	9,058	6%	504
French	1,039	1%	203
French Creole	N/A	N/A	N/A
Italian	N/A	N/A	N/A
Portuguese	N/A	N/A	N/A
German	328	0%	86
Yiddish	N/A	N/A	N/A
Other West Germanic	N/A	N/A	N/A
Scandinavian	N/A	N/A	N/A
Greek	N/A	N/A	N/A
Russian	N/A	N/A	N/A
Polish	N/A	N/A	N/A
Serbo-Croatian	N/A	N/A	N/A
Other Slavic	N/A	N/A	N/A
Armenian	N/A	N/A	N/A
Persian	N/A	N/A	N/A
Gujarathi	N/A	N/A	N/A
Hindi	N/A	N/A	N/A
Urdu	N/A	N/A	N/A
Other Indic	N/A	N/A	N/A
Other Indo-European	2,222	2%	301
Chinese	545	0%	151
Japanese	N/A	N/A	N/A
Korean	99	0%	65
Mon-Khmer, Cambodian	N/A	N/A	N/A
Hmong	N/A	N/A	N/A
Thai	N/A	N/A	N/A
Laotian	N/A	N/A	N/A
Vietnamese	350	0%	101
Other Asian	3,014	2%	366
Tagalog	76	0%	49
Other Pacific Island	N/A	N/A	N/A
Navajo	N/A	N/A	N/A
Other Native American	N/A	N/A	N/A
Hungarian	N/A	N/A	N/A
Arabic	879	1%	253
Hebrew	N/A	N/A	N/A
African	N/A	N/A	N/A
Other and non-specified	681	0%	214
Total Non-English	18,529	13%	1,273

Data Note: Detail may not sum to totals due to rounding. Hispanic population can be of any race.

N/A means not available. **Source:** U.S. Census Bureau, American Community Survey (ACS) 2014 - 2018.

*Population by Language Spoken at Home is available at the census tract summary level and up.

Appendix F
Acronyms and Abbreviations

Appendix F. Acronyms and Abbreviations

AGL - Above Ground Level

APE - Area of Potential Effects

BCC - Birds of Conservation Concern

BVLOS - Beyond Visual Line of Sight

CATEX - Categorical Exclusion

CEQ - Council on Environmental Quality

CFR - Code of Federal Regulations

COA - Certificate of Waiver or Authorization

CoW - Certificate of Waiver

CZMP - Coastal Zone Management Plan

dB - Decibel

DNL - Day-Night Average Sound Level

DOT - Department of Transportation

EA - Environmental Assessment

EJSCREEN - Environmental Justice Screening Tool

EO - Executive Order

EPA - Environmental Protection Agency

ESA - Endangered Species Act

FAA - Federal Aviation Administration

FEMA - Federal Emergency Management Agency

HUD - Housing and Urban Development

IPaC - Information for Planning and Consultation

IPP - UAS Integration Pilot Program

NAS - National Airspace System

NEPA - National Environmental Policy Act

NHPA - National Historic Preservation Act

NMFS - National Marine Fisheries Service

NOA - Notice of Availability

NRHP - National Register of Historic Places

NTSB - National Transportation Safety Board

OpSpecs - Operations Specifications

PSP - Partnership for Safety Plan

RPIC - Remote Pilot in Command

SHPO - State Historic Preservation Office(r)

TDAT - Tribal Directory Assessment Tool

THPO - Tribal Historic Preservation Office

UA - Unmanned Aircraft

UAS - Unmanned Aircraft Systems

USC - United States Code

USFWS - United States Fish and Wildlife Service

Zipline - Zipline International Inc.